JANUARY 10, 1955

Electrical World

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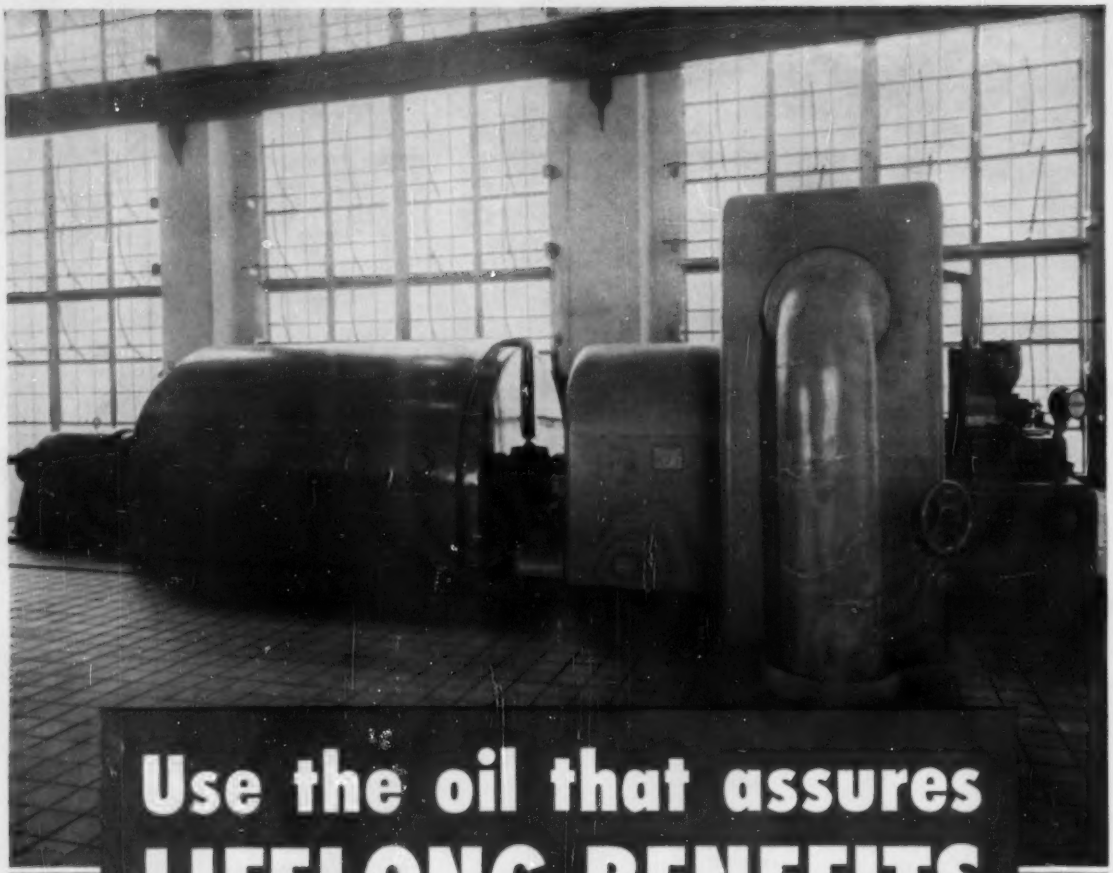
1954 Heat Storm Forces Utilities to Restudy Distribution Design

"Early Bird" Saves Southern Co Money . . . page 82

Facing New Problems in Expanding Transmission . . . page 76

For Electrical World's special report turn to page 65



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Electrical World

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Okolite-Okoprene unshielded 5kv feeders entering basement of the switchgear room from the switchgear above.

Okonite unshielded 5kv cables help Lockheed assemble the Super Constellation

At the Burbank plant of the Lockheed Aircraft Corporation, home of the famous Constellation and Super Constellation, these unshielded 5kv Okolite-Okoprene feeders have been in service since 1941 . . . *and there has never been a failure.* Operating at 4160 volts, the feeders connect the main switchgear room to substations throughout the plant. The latest inspection showed them to be in perfect condition. This is another example of the long, outage-free service given by Okolite-Okoprene rubber-insulated cables.

In the critical, widely-used 3 to 5kv range, ordinary cables must be shielded. However, Okolite-Okoprene cables provide a tremendous advantage because **they do not have to be shielded,** even for voltages as high as 5kv. Here's why. Okolite-Okoprene cables do not develop harmful static discharge. Furthermore, Okoprene has excellent ozone resistance, preventing corona cutting. In addition, Okoprene's high surface resistivity limits the magnitude of longitudinal drainage currents which can flow to ground at a contact point, thereby preventing cable burning.

Thus, users of Okolite-Okoprene cables for 5kv operation are assured all the advantages of unshielded cables . . . reduced cable installation time and cost . . . quick and easy splices and terminations . . . valuable space saved at terminations in crowded junction boxes . . . reduced possibility of cable failure due to improper splicing or terminating techniques.

Okonite's new 128-page Bulletin EW-1085 gives complete information on Okolite-Okoprene rubber-insulated cables in the low voltage range from 0 to 5000 volts. This bulletin includes detailed cable construction features, engineering information, installation and handling techniques, instructions for splicing and terminating. Never before has all this information been compiled in one book. Write for it to The Okonite Company, Passaic, New Jersey.

OKONITE insulated cables

2716

There's an O-B INSULATOR to meet your needs

...quickly available via Graybar!

After you have determined which insulator provides the mechanical and electrical characteristics needed for your particular pole-line requirements, depend on Ohio Brass to produce the very best of the proper type . . . pin type, post, strain, suspension, or spool insulators – all available via Graybar.

Insulators are, of course, a part of the wide range of pole line distribution system materials manufactured by Ohio Brass . . . distributed via Graybar. Constant readiness to serve you is an outstanding Graybar service. With over 110 offices and warehouses strategically located throughout the country, you can depend on us. Graybar has – and will have – quality pole line distribution and transmission materials you need . . . where and when you need them.

And should a difficult problem concerning pole line construction arise – call on a Graybar Outside Construction Specialist to work with your engineers. He'll be glad to help you find the best way to a fast, economical solution. Complete information is yours for the asking – just call the Graybar Representative nearest you. 461-01

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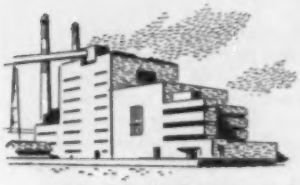
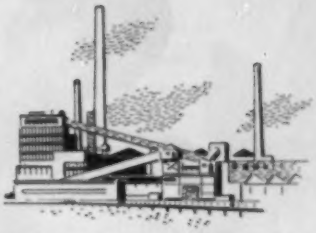
6 new units in 6 years

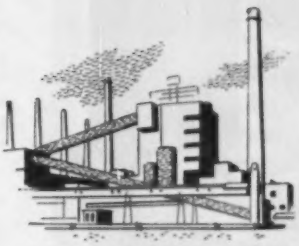
for New England Electric System



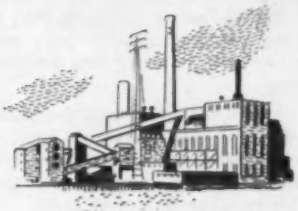
Salem Harbor Station in Salem, Mass.
Two 60,000 kw. units — '51 & '52



Webster St. Station in Worcester, Mass.
30,000 kw. unit — '50



South Street Station in Providence, R. I.
55,000 kw. topping unit — '53



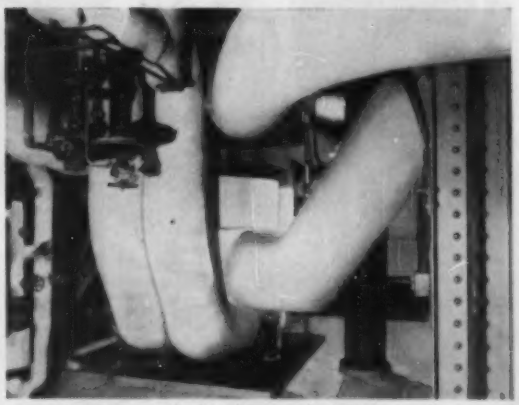
Manchester St. Station in Providence, R. I.
Two 40,000 kw. units — '48 & '49

Proof of the reliability of GRINNELL PREFABRICATED PIPING

Here's a clear-cut case of the value of choosing the right power piping fabricator *from the start!* New England Electric System, when launching its power expansion program, called in Grinnell. Satisfied that Grinnell's facilities rated very high, they okayed Grinnell Prefabricated Piping for the first of a series of new steam-electric generating units. The "proving ground" was to be the unit itself *in service.*

How efficiently that unit performed is written in the record! For starting in 1948, and then each year for 5 consecutive years, Grinnell Prefabricated Piping was employed *exclusively* in constructing 6 new units in the New England Electric System.

This special ability in the fabrication of piping is due to a number of things. Grinnell fabricates in shops under ideal conditions, with modern equipment, by personnel qualified for each class of work. Included in the price (which is determined in advance) are such items of expense as: interpretive engineering, shop sketches and planning, procurement of materials, power services, expendable tools and supplies. There are no charges for waste material or spoilage. All piping is rigidly inspected and tested to comply exactly with customer specifications and applicable codes. Consult Grinnell on *your* next piping installation.



Main steam and reheat lines at reheat intercept valve, Salem Harbor Station.

ATTENTION! *Company Groups and Technical Associations. A 30-minute color sound film showing the quality and economy of Grinnell Shop Fabrication of all classes of piping is available. Write us, giving date desired.*

GRINNELL
WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

THE FROST *PLUS FACTOR* CAN SIMPLIFY YOUR POLE PROBLEMS

. . . save money, too!

Profit-eating pole inventories are unnecessary when you deal with Frost. Buy only as many pressure-creosoted poles as you need when you need them . . . a carload or a trainload . . . and avoid costly handling and storage. We maintain substantial pole stocks in a full range of sizes from which to fill your order in any quantity for quick delivery.

Frost's program of perpetuating its lumber resources through scientific harvesting insures a continuing supply of pole trees from over 450,000 acres of fine Southern Pine timber.

To these natural resources add the skilled technical staff of specialists, and facilities to do the job right and you have the Frost Plus Factor that helps you simpify your pole problems . . . save money, too!

Specify Frost pressure-creosoted poles and send us your next order.

The list of products and services below is indicative of the broad scope of activities engaged in by Olin Mathieson Chemical Corporation of which Frost Forest Products is a proud and respected member.

Frost

FOREST PRODUCTS DIVISION

SHREVEPORT LOUISIANA

R&IE SWITCHES EXCEL

during the HEAT STORM

Performance of switches in the heat storm is a severe test—at a critical time. The peak load and maximum ambients occur simultaneously.

During the heat storm, ample design margins may mean the difference between continuous operation and breakdown...The difference between maximum revenue or maximum loss of revenue right at the peak load.

Here is how R &IE switches help maintain continuous service during these critical periods. More cross-section area of quality material, plus careful, experienced workmanship—in current carrying parts—makes good service possible.

A striking comparison of six leading vertical break switches shows how R &IE Switches Excel—

SWITCH Manufacturer	A	B	C	D	E	R&IE
Weight of current carrying parts (% of A, the lowest)*	100%	107%	110%	111%	117%	133%

*These values compared for 600 Amp., 34.5 Kv. NEMA Standard Switches.

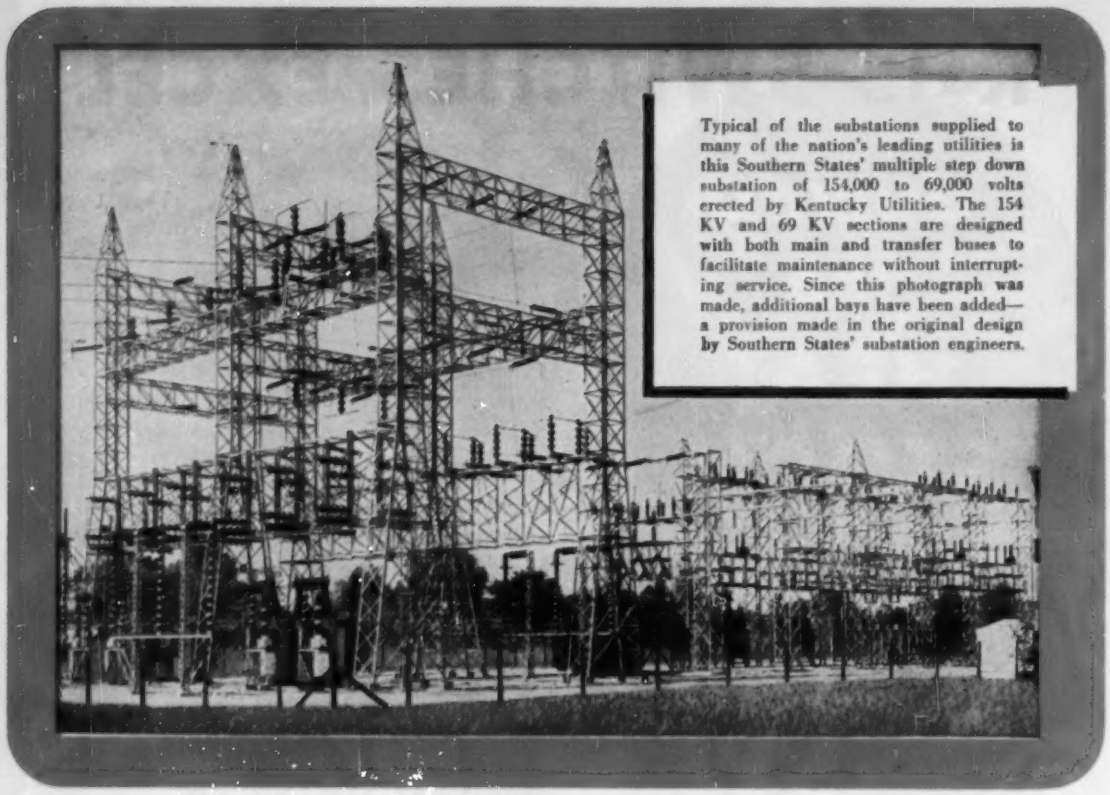
R&IE Type TTR49
HI-PRESSURE BREAK CONTACT
SEALED PRESSURE HINGE CONTACT

Here is significant information to evaluate at the time of switch purchases.

R&IE SWITCHING EQUIPMENT
DIVISION OF I-T-E CIRCUIT BREAKER CO.
GREENSBURG, PA.

STRUCTURES—steel or aluminum ● TESTING DEVICES ● KIRK KEY INTERLOCK SYSTEMS ● ISOLATED PHASE BUS STRUCTURES ● INTERRUPTER SWITCHES

INDOOR BUS SUPPORTS and BUS FABRICATION ● OUTDOOR BUS SUPPORTS and AIR SWITCHES ● SUBSTATION



Typical of the substations supplied to many of the nation's leading utilities is this Southern States' multiple step down substation of 154,000 to 69,000 volts erected by Kentucky Utilities. The 154 KV and 69 KV sections are designed with both main and transfer buses to facilitate maintenance without interrupting service. Since this photograph was made, additional bays have been added—a provision made in the original design by Southern States' substation engineers.

HOW KENTUCKY UTILITIES SAVED TIME AND MONEY ON THIS SUBSTATION

When Kentucky Utilities decided to erect a multiple feeder step down substation at Paducah, Kentucky, it was as simple as one, two, three to get exactly what was needed.

One—a single-line wiring diagram and plat was sent to Southern States; *Two*—our engineers went to work and developed a design for a station that would meet immediate requirements, provide for future bays, and at the same time utilize many standard components which would result in substantial savings of both time and money; *Three*—when final plans were approved, Southern States took care of engineering, production schedules and supplied the steel structure, airbreak switches, disconnects and bus supports.

The result: an efficient, functional substation erected at great savings in time and money to Kentucky Utilities. Once more Southern States' single responsibility service in the design and production of transmission and distribution substations paid off for this progressive utility.

Your company can profit by this experience. Get full facts about this complete "3-Step Plan" from your Southern States' representative, or write direct.

SOUTHERN STATES EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto

"Hurricane-Proof" 110-kv Towers for Florida Power

Steel towers found most economical in central Florida swamplands inaccessible to maintenance crews

In building their new 110-kv transmission line the 25 miles from Ft. Meade to Avon Park, Florida Power Corp. decided that steel towers would give the most reliable service at the lowest cost.

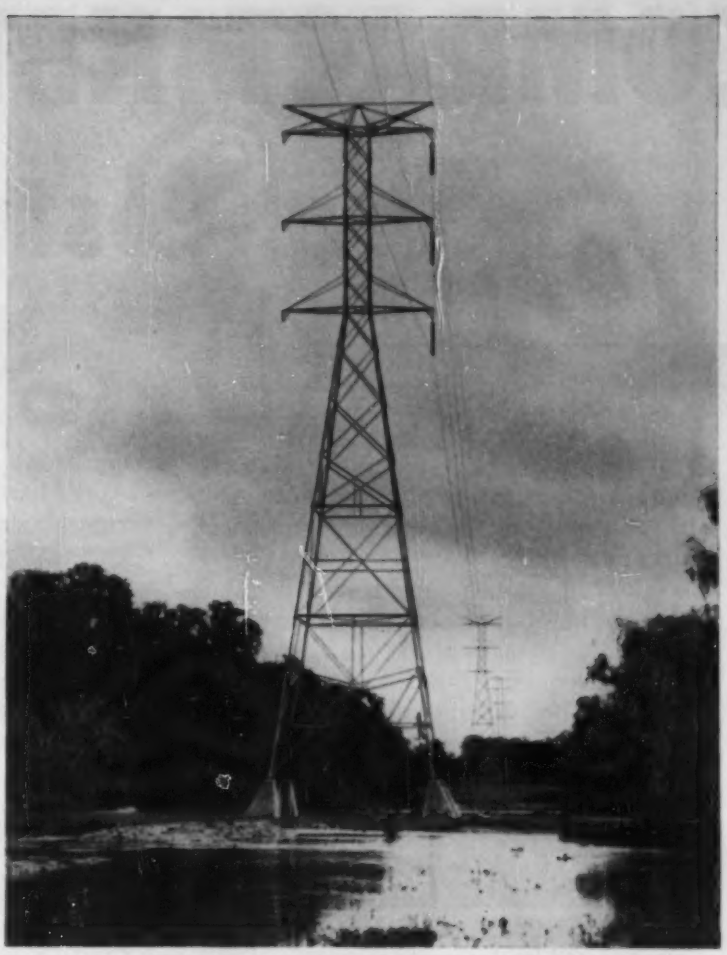
Topmost consideration was the ability of the towers, as designed by Bethlehem engineers, to withstand the hurricanes which frequently hit central Florida. Storm-wrecked towers would result in prolonged outages and costly repairs, especially as the towers, located deep in swamplands, are almost impossible to reach after a hurricane has flooded and devastated the area.

Another factor was line length, which could be kept down by using tall steel towers. This type of construction permits long spans over lakes and swamps that shorter poles, made of materials not as strong as steel, would have to skirt.

"HURRICANE-PROOF" DESIGN... Built to take terrific punishment without failure, the towers were designed to withstand wind loadings of 135 mph and to have an average of 1½ to 2 tripouts from lightning based on the area's isokeraunic level of 90 lightning storms a year.

Each tower weighs about 7½ tons and stands 119 ft high. The design span-length is 1,100 ft, although the average span in the field is 1,028 ft, or about five towers per mile. The towers carry ⅜ in.-copperweld overhead shield wires. The conductors are No. 4/0 stranded copper. The slab-column-type tower footings, considerably larger and deeper than normal, contain 6 yds of reinforced concrete and stand 8½ ft high, with a slab area of 85½ sq ft, 21 in. deep.

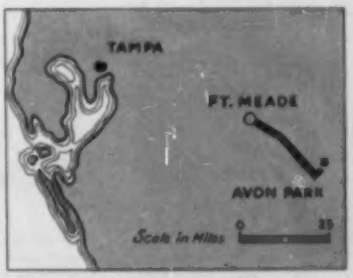
SAVINGS IN TOWER ERECTION . . . Florida Power estimates savings of about $120 per tower by assembling the towers on the ground and lifting them onto the prepared foundations, as compared to the conventional "straight-up" technique. In this way, 11-man crews were able to erect five towers a day.



Tough spot for a maintenance crew to reach! Florida Power selected rugged steel towers to avoid outages due to hurricane damage. The line is shown here crossing treacherous Peace River Swamp.

FABRICATED IN LEETSDALE, PA.... The tower steel for all 135 towers in the line from Ft. Meade to Avon Park was detailed, fabricated and galvanized at the Bethlehem Fabricating Works in Leetsdale, Pa., near Pittsburgh. Other Bethlehem tower-fabricating works are located in South San Francisco, Calif., and Seattle, Wash.

If you would like to have more information about Bethlehem's design and fabrication of transmission towers, we suggest you contact the Bethlehem sales office most convenient to you.



The new line (shown in black) is the final link connecting the 135-mw plant on Tampa Bay with the 60-mw Avon Park plant—southernmost point of the Florida Power System.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

COMPACT NETWORK Save Cost of Vault

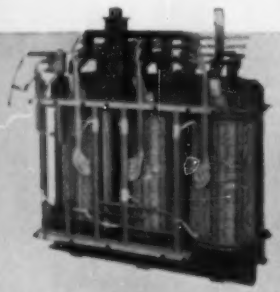
NIAGARA MOHAWK POWER COMPANY solved a space problem with these Allis-Chalmers network transformers. Increasing loads in concentrated areas in Buffalo, N. Y., called for transformers rated higher than those for which the vaults had originally been built. Considerable changes in the vault sizes might have been required. But the compact design of these Allis-Chalmers network units made it possible to fit 750-kva network transformers in vaults that were originally designed for 500-kva transformers.

Fast Delivery

In addition to saving vault reconstruction costs, Allis-Chalmers methods helped handle an unexpected load growth emergency. These units were originally scheduled for delivery in April, 1954. They were actually shipped five months ahead of schedule, thus facilitating system improvements.

1½ Million KVA in Operation

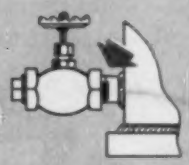
Excellent design, compactness, and good service explain why over 1½ million kva of Allis-Chalmers network transformers are on the job in utilities throughout the country. Utility experience with these units has proved their economy for installation and operation. Before you consider your next network installation, it will pay to get complete facts about Allis-Chalmers network transformers. Call your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4495



Compact, low-loss design. Thermal capacities are high for contingency load conditions. Sturdy, time-proven core and coil construction meets repeated short-circuit stresses of network operation.

DESIGN AND CONSTRUCTION FEATURES

Safe, dependable no-load tap-changing mechanism. Handle inserted through two-inch opening on cover operates the tap-changing mechanism. Handle cannot be removed unless it is in positive tap position. Cover location of handle entrance eliminates packing gland maintenance.



Threaded valve connections to tank are solder-wiped for extra protection. Valves are located for easy access. Globe-type valves with non-rotating seats close tight, avoid wear on valve seats.

Spiral-wound gaskets. Over 6 years' continual use has proved their superiority over other types of gasketing material for sealing bushings in the tank wall. Alternate plies of preformed spring-like metal and non-metallic fillers provide unusual resilience and actually adjust themselves to changes in operating conditions. Gaskets can be installed without cements or grease. They can be quickly removed if required and may be re-used if necessary.

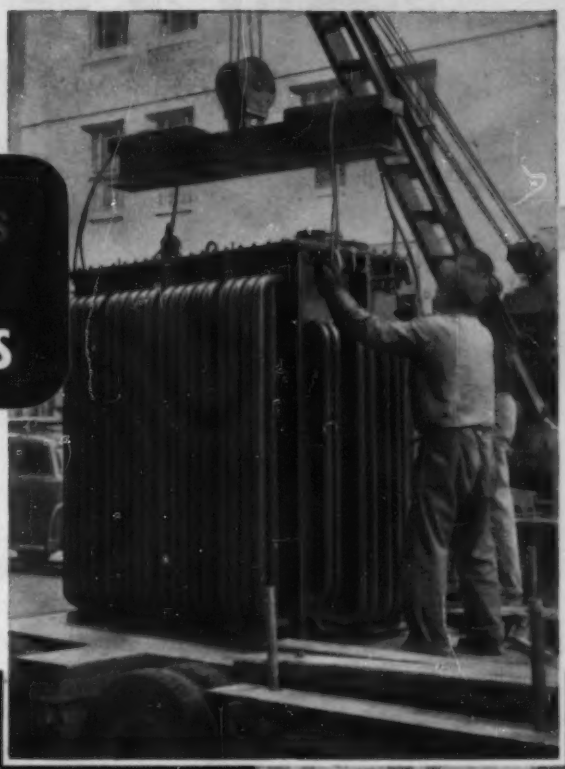
A-C ALLIS-CHALMERS

ALLIS-CHALMERS

TRANSFORMERS
Expansion

ALLIS-CHALMERS

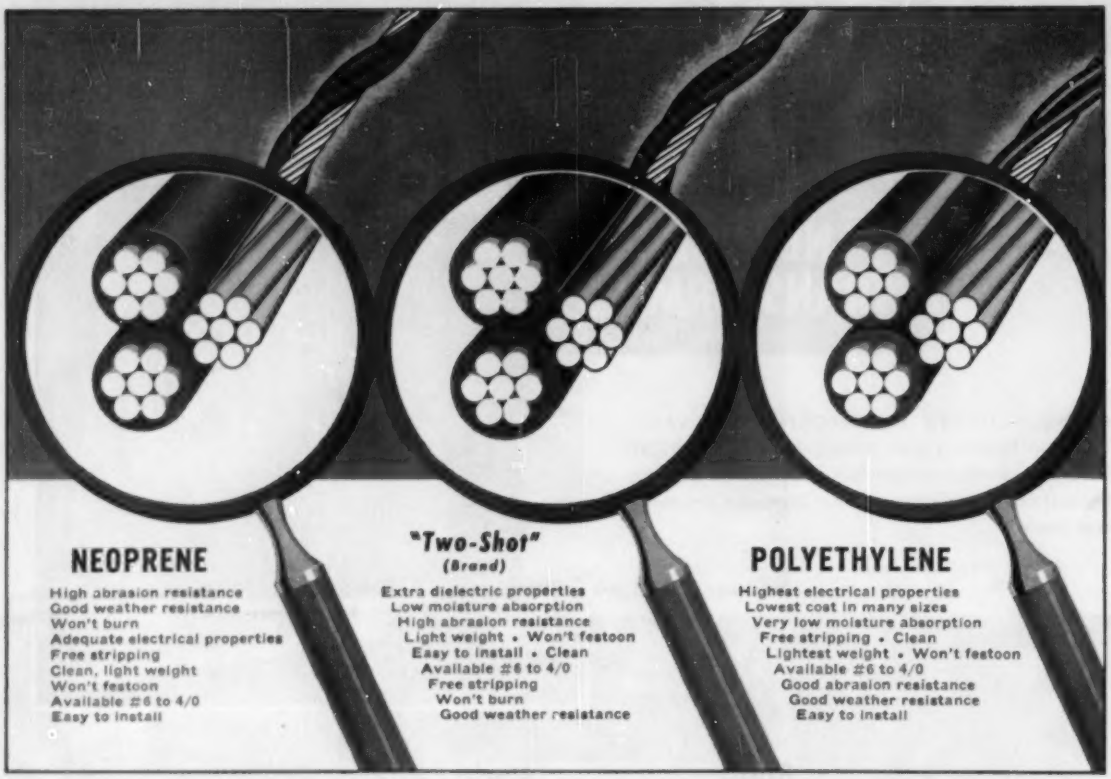
NETWORK TRANSFORMERS



MOVING NETWORK TRANSFORMERS TO VAULT in downtown Buffalo (right). Photo below shows how 750-kva network transformer fits into 500-kva vault, saving utility cost of reconstruction to meet increased downtown power needs.

HEAT STORM OVERLOADS?

Specify K/W. Service Drops!



YOUR CHOICE of service drop insulation is readily available in Kaiser Aluminum's K/W Triplex Trio.

Whether you prefer Neoprene or "Two-Shot" or Polyethylene, you can specify K/W with full confidence of getting the highest quality materials to meet your needs.

For example, if you want a premium-type product, you can order K/W's long-accepted "Two-Shot" Triplex at slight additional cost. The phase wire insulation—a 2/64" inner layer of special rubber (3/64" on stranded wire) with 2/64" jacket of tough Neoprene. "Two-Shot" Triplex provides added dielectric properties and weather resistance.

Otherwise you can specify regular K/W Neoprene or Polyethylene insulated Triplex or covered line wire for open wire services. No matter which conductor you choose, you are assured of long trouble-free service when you use Kaiser Wire.

If your services go through trees, ask your Kaiser Aluminum conductor engineer for advice on suppliers of economical tree guards, or you may want to consider a new Kaiser Aluminum development—"Double D Armored SD."

For complete information on Kaiser Aluminum conductors, contact our sales office listed in your telephone directory or one of our many distributors. Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office*, Palmolive Bldg., Chicago 11, Ill.; *Executive Office*, Kaiser Bldg., Oakland 12, Calif.

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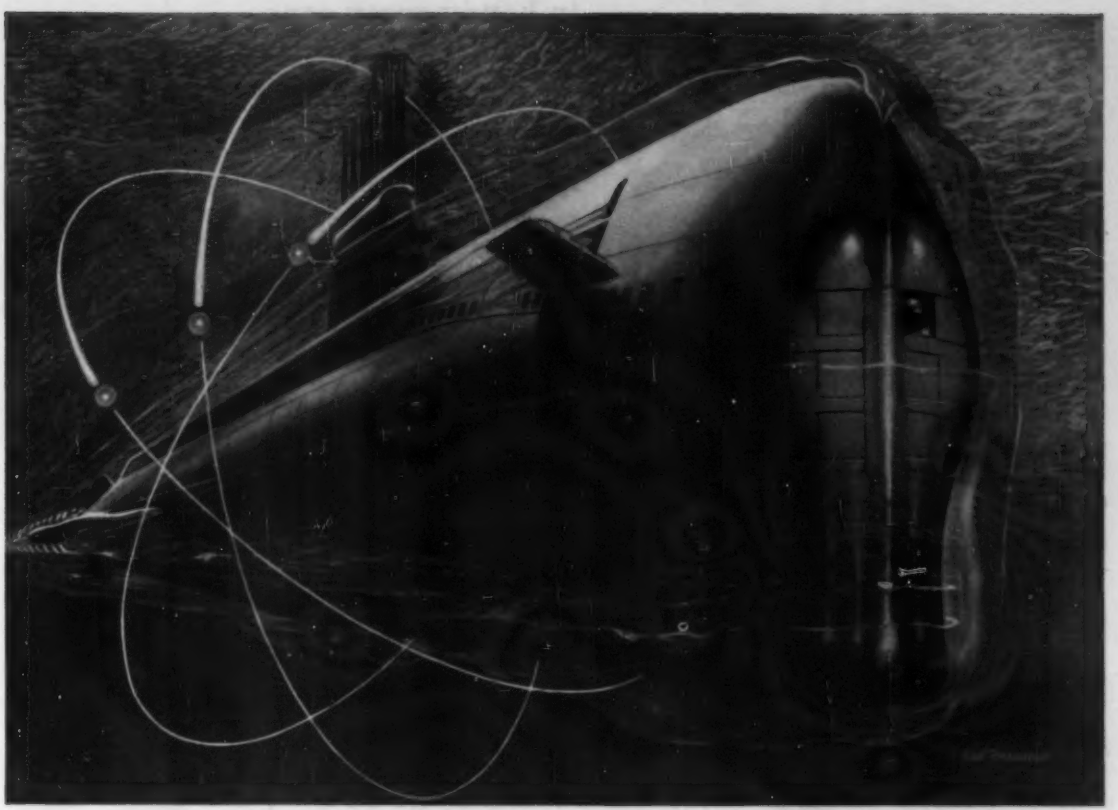
THE NATION'S LARGEST PRODUCER OF TRIPLEX AND ALUMINUM WEATHERPROOF CONDUCTOR

POLYETHYLENE & NEOPRENE WEATHERPROOF AND TRIPLEX • QUADRUPLEX • ACSR
ALL ALUMINUM CONDUCTOR • RECTANGULAR, SOLID ROUND AND TUBULAR BUS



THE "NAUTILUS"

Atomic Sub and Builders Rely on World's Greatest Lubrication Knowledge

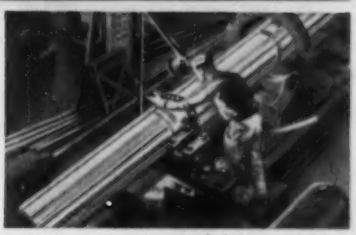
With the launching of the "Nautilus" — world's first atomic-powered submarine — the U.S. Navy crossed the threshold of the atomic age.

Socony-Vacuum is proud that it has been able to play a dual role in this most significant event.

First, famous Socony-Vacuum lubricants are now protecting vital machinery aboard the "Nautilus."

Second, Electric Boat Division, General Dynamics Corp. — builder of the "Nautilus" — relies 100% on our lubricants and a program of Correct Lubrication to protect its plant equipment... has done so for the past 34 years!

We wish the "Nautilus" and her crew all success... pledge our continued cooperation, in every way possible, to the Navy and its suppliers, toward the end of keeping America and her allies strong.



A snorkel intake tube being machined to very precise tolerances on one of the large lathes in the Groton plant.

Hydraulic bender shapes section of 8-in. steel pipe in two minutes. This operation formerly took a full day.

SOCONY-VACUUM *Correct Lubrication*

FIRST STEP IN CUTTING COSTS

SOCONY-VACUUM OIL CO., INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP.

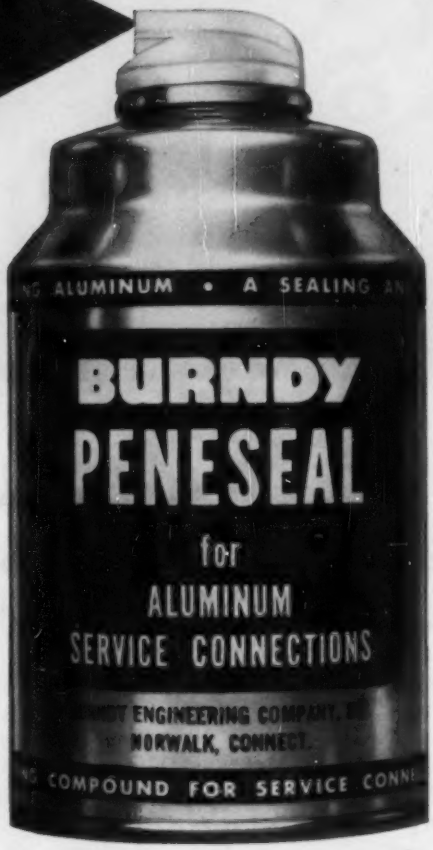
SOCONY-VACUUM

in handy spray cans

BURNDY PENESEAL

a sealing and oxide-inhibiting compound for service connections involving aluminum

- *seals out moisture*
- *prevents galvanic corrosion*
- *insures low contact resistance*



New PENESEAL *is a synthetic polybutene liquid, emitted under pressure from aerosol cans as a whitish foam. This foam changes quickly into a non-drying transparent adhesive film, producing a highly effective seal for service connections under the most extreme weather conditions.*

By neutralizing the oxide film on aluminum, the polybutene element in PENESEAL *renders it remarkably effective in reducing electrical resistance—a property not found in ordinary protective oils and greases. Scratch-brushing of connector and conductor surfaces is recommended for best results.*

Your Burndy representative has sample cans of PENESEAL *to show you. Ask him for a demonstration, or write to* BURNDY—*Norwalk, Connect., Toronto, Canada.*
Factories: *New York, California, Toronto.*
Export: *Philips Export Company.*

AVAILABLE IN 12 OZ. PRESSURIZED CANS; 6 CANS TO A CARTON. A SINGLE CAN HANDLES APPROXIMATELY 50 CONNECTIONS. OPERATES IN TEMPERATURES RANGING FROM 20°-100° F.

It's good business to connect with . . .

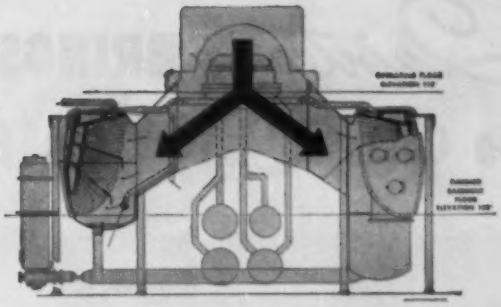
BURNDY

54-22

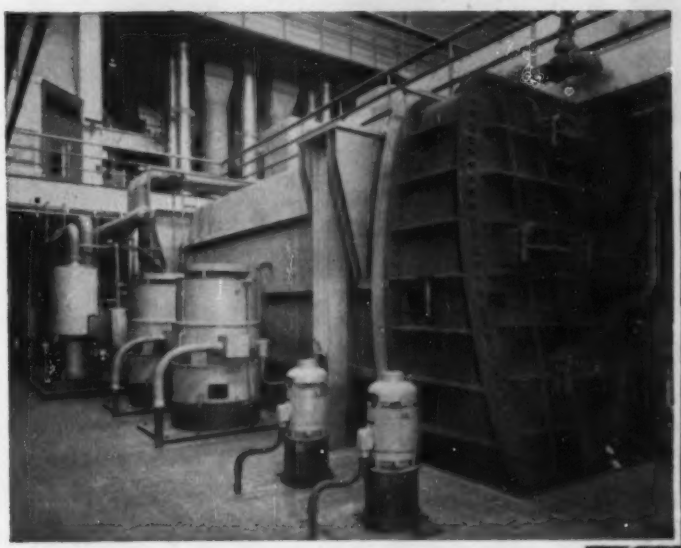
. . . FIRST name in electrical connectors; tools; methods

new angle

in turbine-exhaust-condenser arrangement



saves headroom and construction costs at Kearny Generating Station



One of the FW side-mounted condenser shells from basement level, showing deflection columns, condensate pumps and heater drain pumps.

General view of turbine room at Kearny station, showing one of the twin condenser shells and the side-exhaust turbine.

The slightly unorthodox surface condenser illustrated above is one of two 70,000 sq. ft. side-turbine-exhaust units designed and built by Foster Wheeler for Public Service Electric and Gas Company, N. J. Serving a 145,000 kw turbo generator at the new Kearny Generating Station, it has effected important overall economies in station construction.

Total height from basement level to turbine operating level is only 15 feet. This low height was achieved without appreciable increase in turbine discharge path, which feeds directly into the twin single-pass condenser shells through a short divided exhaust piece. Careful studies showed that the reduction in headroom was a definite economic advantage. The space below the exhaust piece is effectively utilized by four feedwater heaters.

Each half of the condenser shell is suspended from four deflection columns which allow for thermal expansion without the customary expansion joint or spring arrangement.

Specializing in the design and construction of steam generators, surface condensers and feedwater heaters, Foster Wheeler is fully equipped, engineering and productionwise, to meet your requirements for the modern steam plant. For further information write for HE-3-54. Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.

FOSTER WHEELER

Quinterra BRINGS SUBSTANTIAL SAVINGS to Class "B" and Class "H" transformer makers...

. . . each using a different type Quinterra® to meet his needs

THE two "before and after" photographs above do more than show what manufacturers can do when they employ Quinterra as layer insulation. They also demonstrate that the manufacturer is not limited to one type of this thin, flexible, purified asbestos insulation. Any one of several types will help him conserve materials, gain greater safety, raise overload limits, decrease rejects, lessen production costs, and lengthen service life.

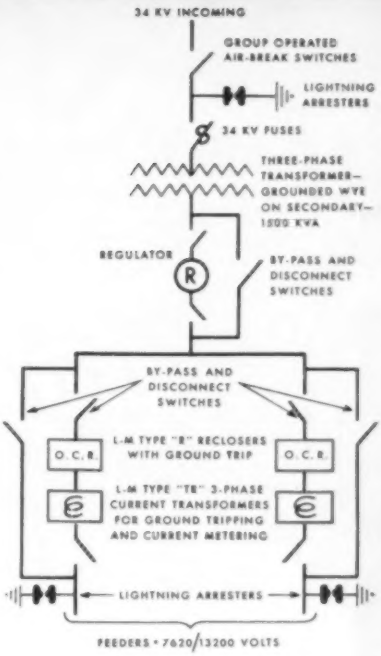
For Class "B" operations, he can choose Type 6 . . . the twin-ply Quinterra treated with polyvinyl acetate. It retains its dielectric strength of about 300 VPM at temperatures above the Class "B" maximum of 130 C. Strongest of the Quinterras, it is made by combining and calendering two layers together into a dense, smooth-surfaced sheet. Its excellent tensile and bursting strengths enable assemblers to reach favorable production rates. And it also provides a large square foot per dollar coverage*.

For Class "H" operations or for high processing and ambient temperatures, the manufacturer can choose single-ply silicone-treated Quinterra Type 3. Its dielectric strength of about 300 VPM is retained under continuous exposure to temperatures higher than 180 C, the Class "H" maximum. It also has good moisture-resistance, flexibility, and adequate physical strength for many applications.

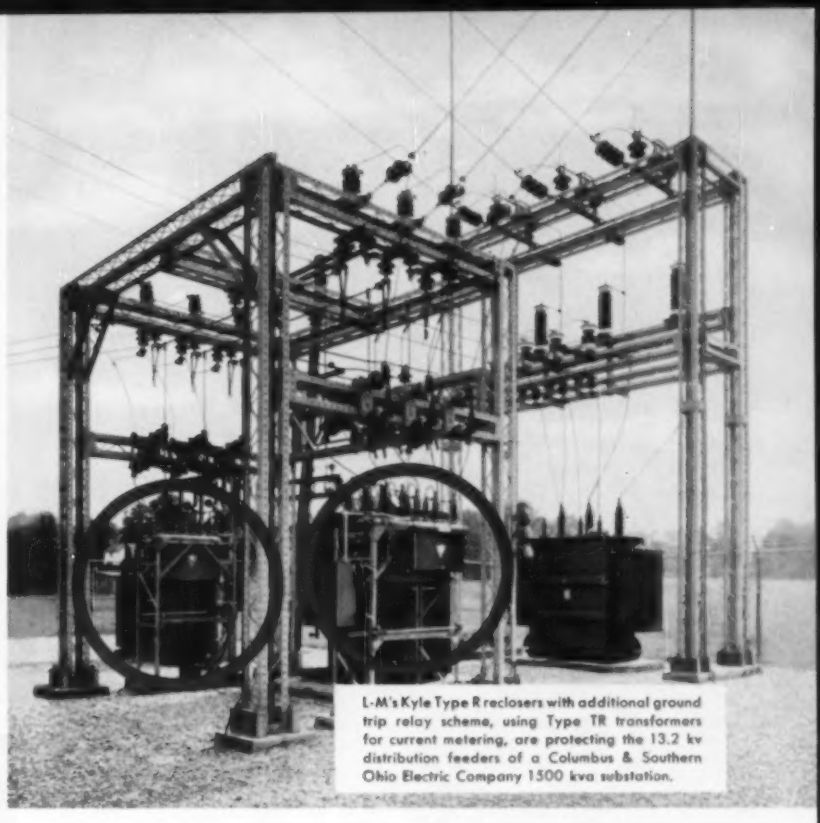
Each of these Quinterras is made of the same highly purified asbestos base sheet that has the inherent dielectric . . . and has a hole-free, closed structure. They differ only in the saturant used and in the number of plies. For further information and samples of Quinterra, write to Johns-Manville, Box 60, New York 16, N. Y. No cost or obligation.

*Also true of its companion product, Quinterra Type 5, which is preferable for applications where maximum mechanical strength is not required.

JM PRODUCTS Johns-Manville ELECTRICAL INSULATIONS



One line diagram of the substation at right. This 34 kv to 13.2 kv substation has a bus regulator and two 100 amp. Kyle Type R heavy-duty reclosers, assuring quality and continuity of service to the customer at all times.



L-M's Kyle Type R reclosers with additional ground trip relay scheme, using Type TR transformers for current metering, are protecting the 13.2 kv distribution feeders of a Columbus & Southern Ohio Electric Company 1500 kva substation.

Take Advantage of Additional Protective Schemes . . .

New Control Devices Now Available with Kyle Type R 3-Phase Reclosers

Methods are given for obtaining auxiliary protective schemes used to supplement the normal series over-current tripping of the recloser.

By **R. C. KIRK**
Manager
Kyle Products Sales
Line Material Company

Electric service continuity is essential today, as customers depend more and more on electricity for operation. Utility engineers as well as Line Material engineers are aware of the problems involved in designing and operating a protected system economically.

To meet this challenge, L-M engineers have developed a heavy-duty recloser that provides simultaneous tripping of all three phases on feeders with heavy loads and high fault currents. This recloser provides series tripping, reclosing, and dual timing to permit coordination with fuses; and offers facilities to adapt almost any auxiliary relays and indicating equipment to it. Thus it provides the best protective scheme for your system.

Applications for the Type R

The Kyle Type R recloser is a self-contained unit that can be installed on a line pole as well as in a substation. It is a rugged, power-class recloser designed to replace breakers in substations with up to 100,000 kva fault capacity. In addition to segregating permanent faults from the system, the Type R recloser is capable of clearing faults of a transient nature much faster than is normally accomplished with station breakers.

Type R reclosers are also installed on the feeders outside substations that have slow breaker operations, providing for fast (2-cycle, maximum) fault clearing time. This effectively and economically improves operation, provides transient fault protection for the distribution system, relieves the duty on the station breakers, reduces the number of service calls, and greatly enhances service continuity.

Almost any supplementary relaying scheme is adaptable to the Type R recloser operation:

Ground Trip Solenoid is a self-contained ground relay possessing its own dual time-current characteristics.

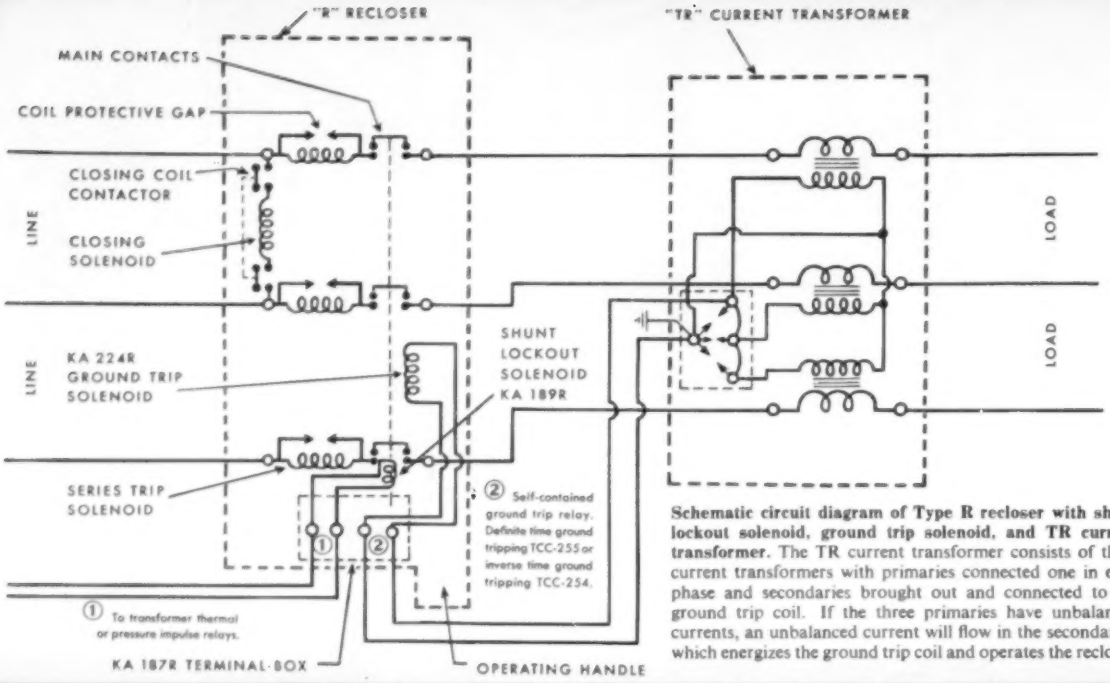
Shunt Trip Solenoid is a tripping device only, designed to operate the recloser when energized from a supplementary relay scheme.

Shunt Lockout Solenoid is a lockout device only; locks out the recloser instantly. Like the shunt trip solenoid, it is energized by remote control.

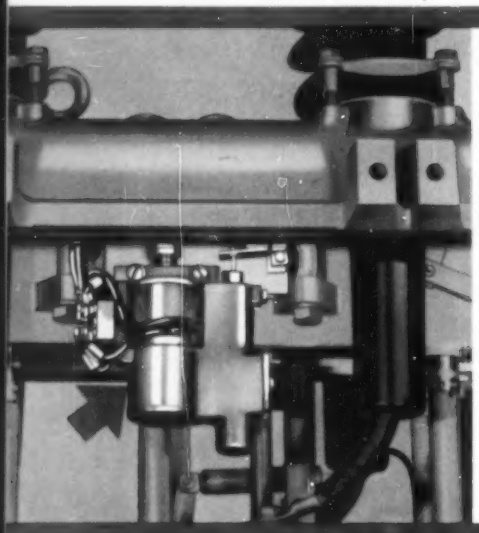
Auxiliary Switch provides positions for remote-control indication or low-voltage-control switching of apparatus used in conjunction with the Type R recloser.

See Protective Schemes on Next Three Pages ▶

LINE MATERIAL Kyle® Reclosers



Schematic circuit diagram of Type R recloser with shunt lockout solenoid, ground trip solenoid, and TR current transformer. The TR current transformer consists of three current transformers with primaries connected one in each phase and secondaries brought out and connected to the ground trip coil. If the three primaries have unbalanced currents, an unbalanced current will flow in the secondaries, which energizes the ground trip coil and operates the recloser.

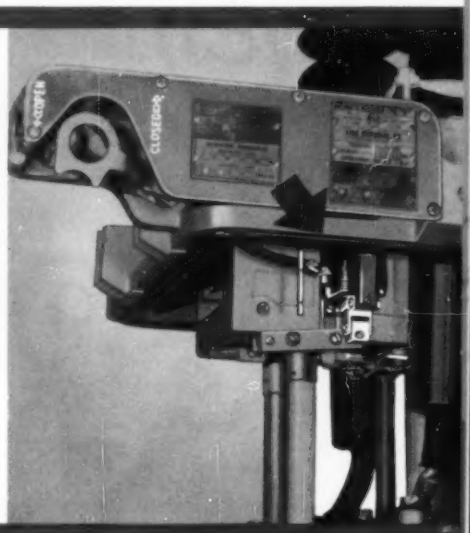


Ground Trip Solenoid

is a self-contained relay possessing its own dual time-current characteristics. It is energized by an unbalanced current from paralleled secondaries of three current transformers. Total operations to lockout and reclosing time remain the same as in series tripping.

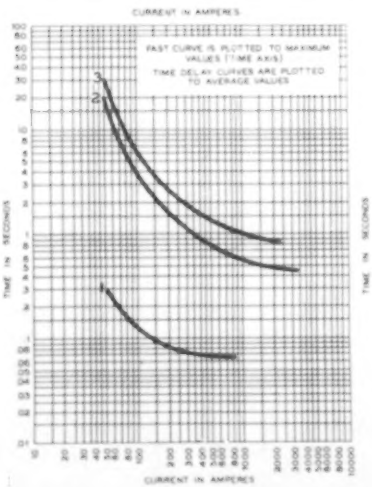
Shunt Lockout Solenoid

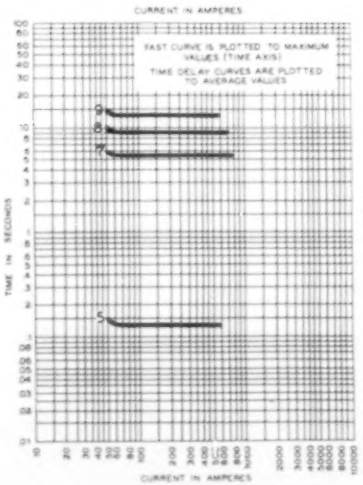
is a lockout device only, operated by remote control. When energized, this solenoid acts upon the recloser lockout mechanism to open the main contacts and lock out the closing coil switch to prevent reclosing. Maximum clearing time of the Type R, following energizing of the shunt lockout solenoid, is 7 cycles.



Time Current Curves

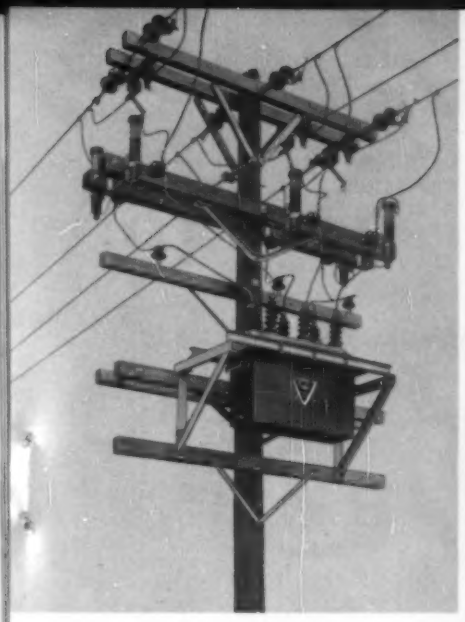
Inverse Time Ground Tripping TCC-254. Note: Horizontal ordinate may be reindexed for other minimum trip settings (67, 100, 133, 200, and 400 amps.).


CURRENT IN AMPERES
FAST CURVE IS PLOTTED TO MAXIMUM VALUES (TIME AXIS)
TIME DELAY CURVES ARE PLOTTED TO AVERAGE VALUES
TIME IN SECONDS
CURRENT IN AMPERES

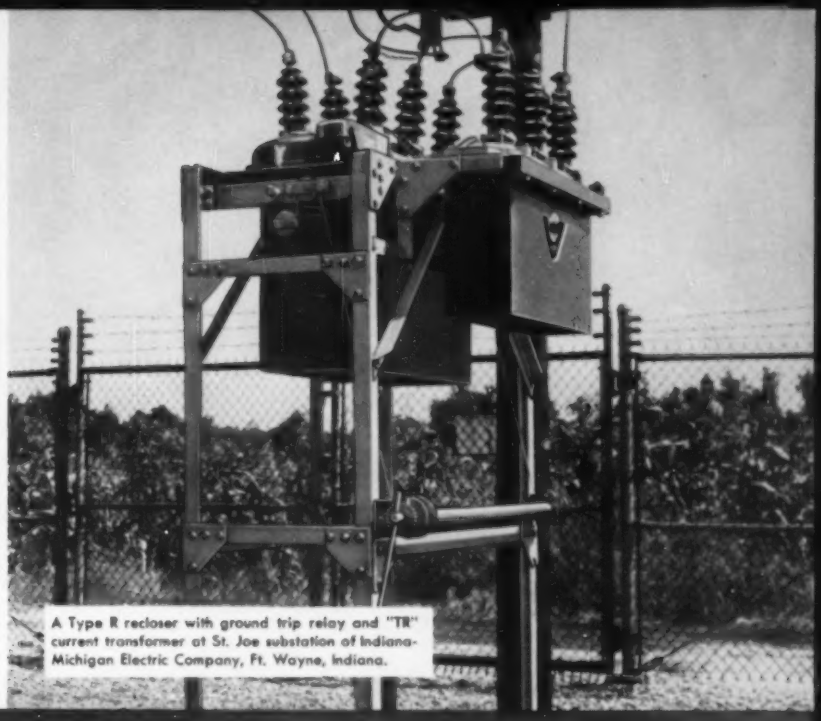

CURRENT IN AMPERES
FAST CURVE IS PLOTTED TO MAXIMUM VALUES (TIME AXIS)
TIME DELAY CURVES ARE PLOTTED TO AVERAGE VALUES
TIME IN SECONDS
CURRENT IN AMPERES

Time Current Curves

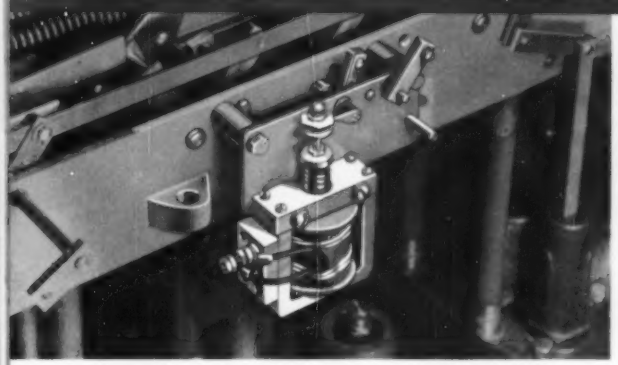
Definite Time Ground Tripping TCC-255. Note: Horizontal ordinate may be reindexed for other minimum trip settings (67, 100, 133, 200, and 400 amps.).



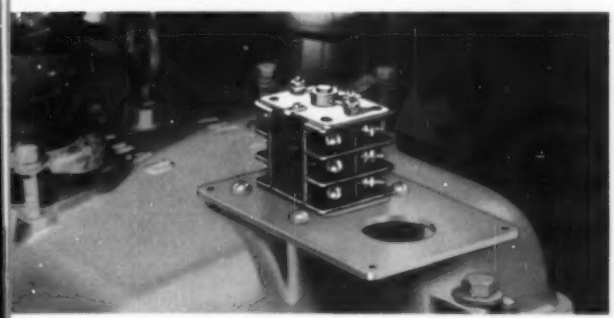
A pole-mounted Type R recloser protecting 7.2/12.47Y kv distribution feeder of a southwestern power company.



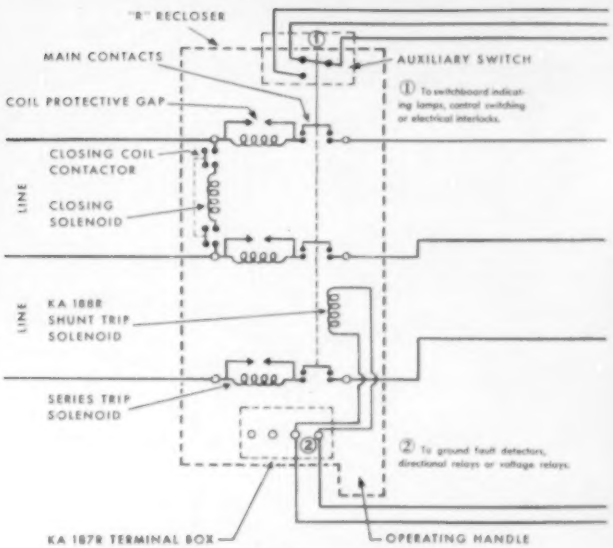
A Type R recloser with ground trip relay and "TR" current transformer at St. Joe substation of Indiana-Michigan Electric Company, Ft. Wayne, Indiana.



Shunt Trip Solenoid is a tripping device only, possessing no time-current characteristics and no intended time-delay. It is designed to operate the recloser when energized by relay or control systems established by the utility engineers to supplement series tripping. Total operations to lockout and reclosing time remain the same as in series tripping. Unlike series or ground tripping, the shunt trip may be energized from a source not affected by recloser operation. The shunt trip may be used in place of, and interchangeably with, the ground trip solenoid. Clearing time is 4 cycles, maximum, plus relay time.



Auxiliary Switch may be a one-, two-, or three-stage unit, used for remote-position indicating or low-voltage-control switching of apparatus used in conjunction with the Type R recloser. Up to six sets of contacts in any combination of positions can be provided.



Schematic circuit diagram of Type R recloser with shunt trip solenoid and auxiliary switch.

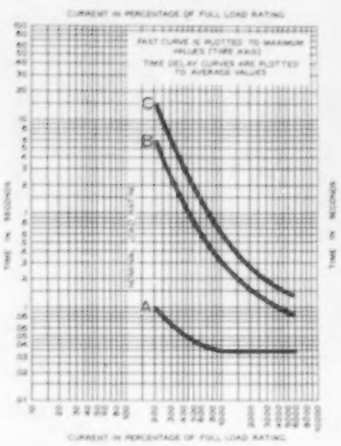
The shunt trip solenoid operates the recloser when energized by auxiliary relay schemes. Applications for the Type R recloser include replacing outmoded substation circuit breakers. At times it is desirable to retain the existing relay schemes. This can be accomplished by using the shunt trip solenoid to operate the recloser.

The auxiliary switch is connected by a mechanical linkage to the recloser contact operating mechanism. There are two sets of contacts per stage that can be set for "A" closed when the main contacts are closed, or "B" open when the main contacts are closed. Up to six sets of contacts in any combination of "A" or "B" can be provided to operate auxiliary equipments when the recloser operates.

LINE MATERIAL
Kyle® Reclosers

Continued ▶

Time-Current Curves
Phase Tripping TCC-253


CURRENT IN PERCENTAGE OF FULL LOAD RATING
FAST CURVE IS PLOTTED TO MAXIMUM VALUES (TIME AXIS)
TIME DELAY CURVES ARE PLOTTED TO AVERAGE VALUES
C
B
A
TIME IN SECONDS
CURRENT IN PERCENTAGE OF FULL LOAD RATING

Overcurrent Protection

The series trip solenoid activates overcurrent tripping of the unit. It has a selection of three time-current characteristics: Fast (A), Retarded (B), and Extra-retarded (C), with four operations to lockout in any of seven sequences. The series tripping mechanism of each phase operates its own time-delay unit. Where the fault is 3-phase, phase-to-phase, or phase-to-ground, it will not affect the timing of the recloser. With this time-delay arrangement, the time for clearing multi-phase faults is determined by the largest current.

A Type R recloser display truck is available for demonstrating to members of your organization the construction, operation, and application of L-M's Kyle Type R recloser.

Get the Whole Story on Type R Reclosers

Ask your L-M Field Engineer to schedule a demonstration for you and to furnish you with copies of Bulletin CR1C on the heavy-duty Type R recloser. Or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

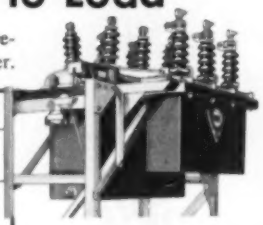
Complete Coordinated Automatic Protection from Substation to Load

Only L-M offers the fully coordinated series of single-phase and 3-phase reclosers that permits complete automatic protection from substation to user.

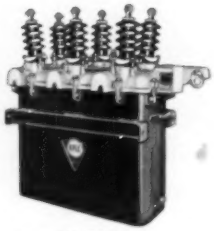
Complete Coordinated Automatic Protection from Substation to Load

Distribution Class Nominal Rating 14.4 kv BIL 95 kv			Intermediate Duty Nominal Rating 23 kv BIL 150 kv				Heavy Duty Nominal Rating 14.4 kv BIL 110 kv			
Single-Phase Type H Three-Phase Type 3H			Single-Phase Type E Three-Phase‡				Single-Phase Type L Three-Phase Type R			
Rating Amps.	Min. Trip Amps.	Inter. Rating* 14.4 kv	Rating Amps.	Min. Trip Amps.	Inter. Ratings* RMS Amperes 14.4 kv	23 kv	Rating Amps.	Min. Trip Amps.	Inter. Ratings* RMS Amperes 4.8 kv	14.4 kv
5	10	125	5	10	200	125				
10	20	250	10	20	400	250				
15	30	375	15	30	600	375				
25	50	625	25	50	1000	625	25	50	1500	1500
35	70	875	35	70	1400	875	35	70	2100	2100
50	100	1250	50	100	2000	1250	50	100	3000	3000
			70	140	2500	1750	70	140	4200	4000
			100	200	2500	1750	100	200	6000	4000
							140	280	6000	4000
							160†	320	6000	4000
							185†	370	6000	4000
							200β	400	6000	4000
							225†	450	6000	4000
							280†	560	6000	4000

*Recloser interrupting ratings are based on a maximum test circuit X/R ratio of 8 and the asymmetrical rating in total RMS amperes is 1.4 times the symmetrical rating given in the table.
†Available in 3-phase Type R only.
βAvailable in single-phase Type L only.
‡Electrical interconnection available to give 3-phase lockout.



Type R, 3-Phase 280 Amperes—up to 6000 amperes interrupting capacity at 4.8 kv, 4000 amperes at 14.4 kv. Available with ground trip solenoid and other accessories, making it the most versatile recloser available.



Type 3H, 50 Amperes—3-phase protection up to 1250 amperes interrupting capacity at 14.4 kv. Available with shunt lockout coil for remote electrical lockout.

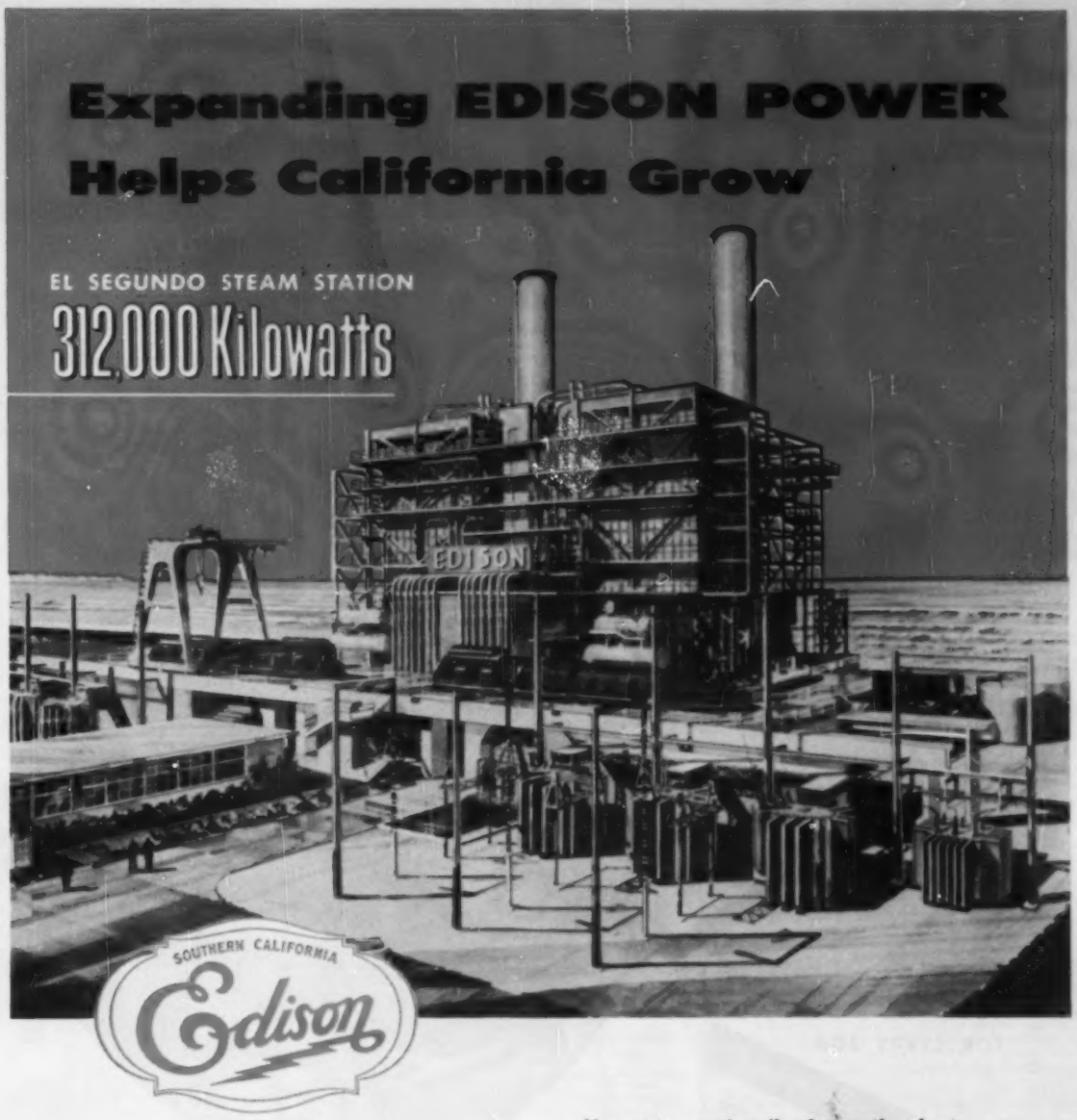
Type L, 200 Amperes—heavy-duty single-phase protection up to 6000 amperes at 4.8 kv, 4000 at 14.4 kv.

Type E, Single-Phase 100 Amperes—intermediate duty, 23 kv; interrupts up to 2500 amperes at 14.4 kv, 1750 amperes at 23 kv. Available with electrical interlock for 3-phase lockout.

Type H, Single-Phase 50 Amperes—interrupting capacity up to 1250 amperes at 14.4 kv.

LINE MATERIAL
Kyle® Reclosers

Expanding EDISON POWER Helps California Grow



In one of the fastest growing areas in the country, Southern California Edison Company keeps the power supply well ahead of mounting demand by a continuous expansion of facilities.

An important new plant – the 312,000-kilowatts El Segundo Steam Station – will go into service next summer with the first of its two generating units. Located adjacent to a major oil refinery, the plant is designed to operate on petroleum fuels with maximum efficiency and economy.

Working in close cooperation with the engineering and construction department of the Edison Company, as it has for a number of years on various projects, the Bechtel organization has been assigned unified responsibility for the engineering design and construction of this plant.

BUILDERS FOR INDUSTRY

BECHTEL

BECHTEL CORPORATION

Los Angeles · **SAN FRANCISCO** · *New York*

guaranteed footage ...plus

You get full measure with every roll of Jenkins Gold Seal Tape.

But what's even more important, every inch measures up to the Gold Seal standard, which makes every roll go further. It has lasting "tack" in any weather.

A few neat wraps and the job's finished . . . one thickness insulates. Get the most "coverage" per roll . . . specify Gold Seal.

Jenkins Bros. (Rubber Division),
100 Park Ave., New York 17.

JENKINS
GOLD SEAL TAPE
FOR EVERY JOB

Available in 10-roll cartons or single rolls. Every roll cellophane protected to stay factory-fresh.

JENKINS
Gold Seal Tape

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM Specifications.

A PRODUCT OF JENKINS BROS....

MAKERS OF FAMOUS JENKINS VALVES

Capacitance Bridge

Measures Insulation Characteristics with High Accuracy

Capacitance ±0.1%

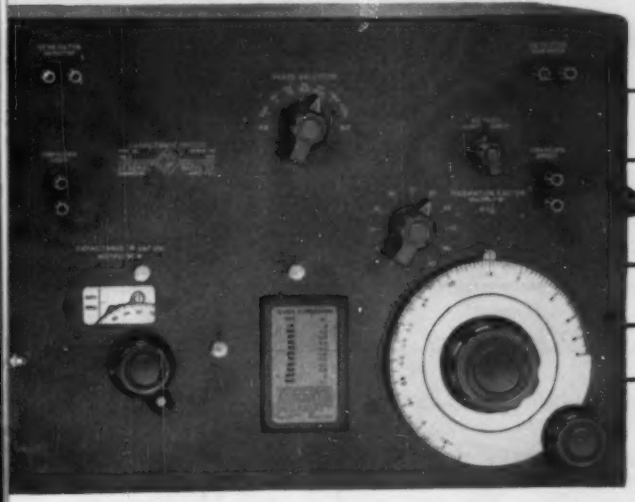
Dissipation Factor ±0.00005

Dielectric constant and power factor are important characteristics of the insulation used in commercial power transformers. Insulating materials will heat up if power factor losses are high. Heating in turn increases power factor which again increases heating . . . . this destructive cycle can ruin expensive equipment. If power factor is controlled within permissible limits, the losses can be minimized to prevent damage.

Westinghouse's Transformer Division, Manufacturing Engineering Department tests all insulating materials used in their equipment. They rely on precision G-R laboratory measuring instruments to do this job for them.

The basic instrument for capacitance and dissipation factor measurements is the G-R Type 716-C Capacitance Bridge. This is the instrument which is used the world over for the accurate measurement of insulating-material characteristics and their change with such factors as frequency, temperature, and humidity. In addition to measurements on all types of capacitors, the bridge is capable of measuring resistance and parallel capacitance of high-valued resistors, inductance and storage factor of inductors, characteristics of electrolytes and many other impedances by substitution measurements.

Photo courtesy Westinghouse Electric Corp.



SPECIFICATIONS

	Direct Reading Measurements	Substitution Measurements
Capacitance Range	100 $\mu\mu$f to 1 μf at 1 kc; 100 $\mu\mu$f to 1000 $\mu\mu$f at 100 c, 10 kc and 100 kc	0.1 $\mu\mu$f to 1000 $\mu\mu$f with internal standard; to 1 μf and higher with external standards
Accuracy Capacitance Readings	±2 $\mu\mu$f times capacitance multiplier reading (better than ±0.2% of full scale for each range)	±0.2% or ±2 $\mu\mu$f, whichever is larger; ±0.1% or ±0.8 $\mu\mu$f using correction chart given on panel; ±0.1% or ±0.2 $\mu\mu$f with worm calibration, available at $50 extra charge
Dissipation Factor Range	0.00002 to 0.56	0.56 times the ratio of the standard capacitance with unknown disconnected to that of the unknown
Accuracy Dissipation Factor Readings	±0.00005 or ±2% of dial reading, whichever is larger	±0.00005 or ±2% for change in observed reading

Frequency Range — accuracies given above hold from 30 c to 300 kc; special Type 716-CS1 available for use between 0.5 Mc. and 1 Mc.

Excellent Shielding — ratio arms, dissipation-factor capacitors, and shielded transformer are enclosed in an insulated shield; unknown terminals are shielded so that zero capacitance across them is not greater than 1 $\mu\mu$f; dust cover and aluminum panel form complete external shield.

Type 716-CR Capacitance Bridge
(relay-rack mounting) $525

Type 716-CM Capacitance Bridge
(mounted in walnut cabinet) $570

Recommended accessories for use with the Capacitance Bridge are the Type 1302-A Oscillator as the power source, Type 1231-B Amplifier and Null Detector, Type 1231-P Filters and the Type 1690-A Dielectric Sample Holder for measurements on unguarded dielectric materials.

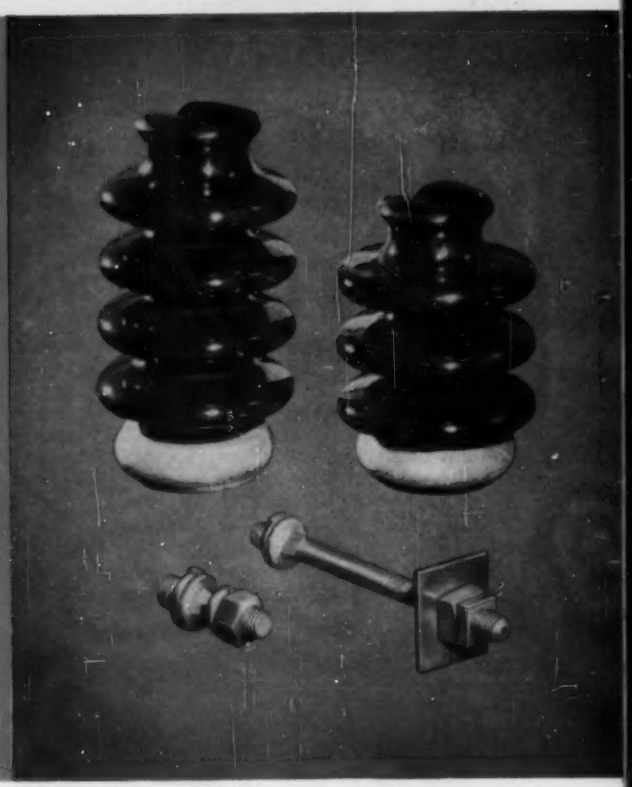
GENERAL RADIO Company

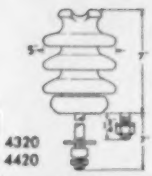
275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

90 West Street NEW YORK 6
8055 13th St., Silver Spring, Md. WASHINGTON, D.C.
920 S. Michigan Avenue CHICAGO 5
1000 N. Seward Street LOS ANGELES 38

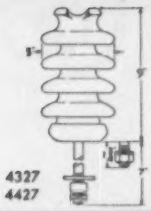
ADMITTANCE METERS
AMPLIFIERS
COAXIAL ELEMENTS
DISTORTION METERS
FREQUENCY MEASURING APPARATUS
FREQUENCY STANDARDS
IMPEDANCE BRIDGES
LIGHT METERS
MEGOHMMETERS
MODULATION METERS
MOTOR CONTROLS
NULL DETECTORS
OSCILLATORS
PARTS & ACCESSORIES
POLARISCOPES
PRECISION CAPACITORS
PULSE GENERATORS
R-L-C DECADES
R-L-C STANDARDS
SIGNAL GENERATORS
SOUND & VIBRATION METERS
STROBOSCOPES
TV & BROADCAST MONITORS
U-H-F MEASURING EQUIPMENT
UNIT INSTRUMENTS
VARIACS®
V-T VOLTMETERS
WAVE ANALYZERS
WAVE FILTERS

ANNOUNCING LAPP DISTRIBUTION POST INSULATORS





4320
4420



4327
4427

CATALOG NUMBER — Short stud unit / Long stud unit	4320 / 4420	4327 / 4427
DIMENSIONS		
Leakage Distance, inches	11	15
Dry Arcing Distance, inches	5.75	7.6
MECHANICAL VALUES		
Cantilever Strength, pounds	1500	1500
ELECTRICAL VALUES		
Recommended Line Voltage, Kv	20	27
Low Frequency Dry Flashover, Kv	80	95
Low Frequency Wet Flashover, Kv	55	65
Impulse Flashover—Positive, Kv	105	135
Impulse Flashover—Negative, Kv	130	190
RADIO INTERFERENCE		
Test Voltage Rms to Ground, Kv	15	15
Max. RIV, Microvolts at 1,000 Kc	100	50
PACKING AND SHIPPING		
Net Weight, each, pounds	7.7	9.5

. . . trouble-free insulation for lines operating at voltages up to 25 Kv

NOW all the operating security of the famous Lapp Line Post insulator for transmission duty is available in a new series of Lapp Post insulators for distribution use—at voltages up to 25 Kv.

SOLID ONE-PIECE PORCELAIN. The body is a solid porcelain without internal hole, machined all over including conductor and tie wire grooves. Base is externally attached and studs are interchangeable—any required length being available.

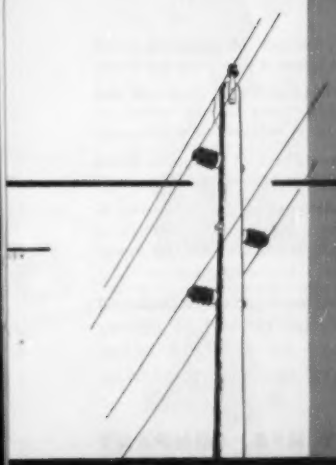
FOG-TYPE. Multiple short petticoats, characteristic of Lapp Fog-Type design, provide an exposed uniform leakage path and self-cleaning feature—most efficient for duty in contaminated atmosphere.

LIGHTNING- AND MECHANICAL-ATTACK RESISTANT. Short sturdy petticoats—such as have been proved by nearly 25 years of service on Lapp Line Posts—provide greatest protection from damage by arcover and attack by stones or bullets.

NO CRACKING. The porcelain, held in the large-area low-intensity grip of its cemented-on base, can be loaded only in compression. No internal bursting forces can develop—permanently free from cracking.

PUNCTURE-PROOF. Solid electrical porcelain from conductor to base—no internal conductive pins, or even air space. Completely puncture proof.

RADIO-FREE. The Lapp Post design is inherently free from radio interference—requires no treatment or coatings. Dependably and permanently free from radio or television interference.



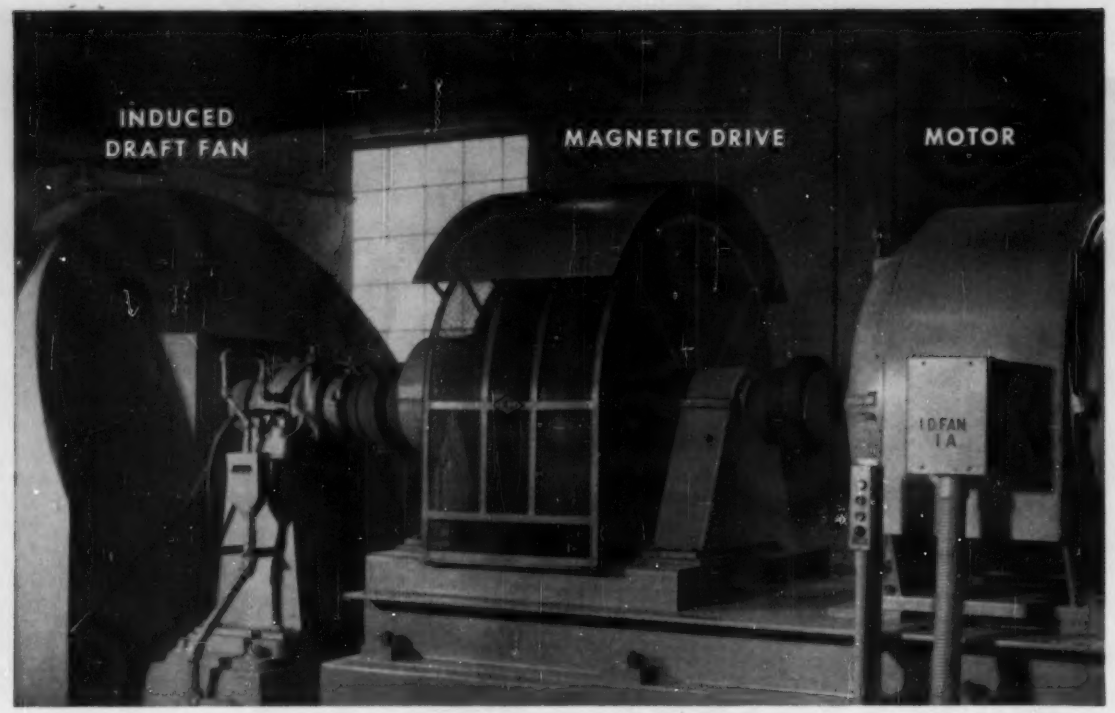
A *BETTER* DISTRIBUTION LINE AT *LOWER* COST...

MOUNT LAPP POSTS *HORIZONTALLY*

You can eliminate cross-arms, braces, brackets and other hardware, by horizontal mounting of Lapp Distribution Posts. Such a line is trim and neat, and the insulators have even better electrical characteristics than when mounted vertically. (Several companies have used such a construction with regular Lapp Line Posts for periods up to 20 years—and they report that these lines have the best operating records of any lines on their systems!)

Lapp Insulator Co., Inc., Le Roy, N. Y.

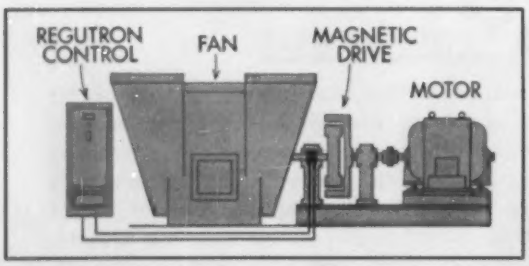
Lapp



Now 18 E-M Magnetic Drives for Potomac Electric Power Company

● The clean, compact E-M Magnetic Drive above gives adjustable speed for an induced draft fan at the Potomac Electric Power Company Buzzard Point plant, Washington, D.C. This Drive is rated at 550 hp, 850/90 rpm. The first Magnetic Drives were installed by this large, rapidly growing utility in 1941.

These E-M Magnetic Drives transmit torque electromagnetically from constant-speed a-c drive motors to vary the speed of the fans. The Magnetic Drive responds precisely to the speed dictated by the automatic combustion control.



E-M MAGNETIC DRIVE SYSTEM for induced draft fan speed control consists of a constant-speed motor, the Magnetic Drive, and the E-M "Regutron" Speed Control. Operating speed of the "magnet" coupled to the fan shaft is held at the desired value by the "Regutron" which supplies d-c excitation to the "magnet" in accordance with the demands of the combustion control system.

Among the advantages of Magnetic Drive speed control you will find:

1. **Savings in Driving Power.** Because fan operating speed is no more than required, drive power is used most sparingly.

2. **Reduced Blade Erosion.** When boiler load is reduced and fan speed is reduced accordingly, "sand blasting" effect on the blades by airborne particles is reduced to a minimum.

3. **Precise Control of Air Flow.** The E-M Magnetic Drive maintains fan speed to within plus or minus *one-half percent!*

4. **Easy and Economical Maintenance.** The Drive and its control contain few moving parts. It is simple to understand and requires little maintenance. No auxiliary cooling equipment needed.

Ask your nearest E-M sales engineer for more facts and figures on this simple, economical method of driving draft fans. And write the factory for E-M Publication No. 1107 containing pictures and data on typical Magnetic Drive applications.

ELECTRIC MACHINERY MFG. COMPANY

MINNEAPOLIS 13, MINNESOTA

4400-TPA-2151

E-M

Magnetic Drives **MAKE DRAFT FANS DO EXACTLY WHAT YOU WANT THEM TO**

In electrical installations *where QUALITY counts* use CONDULETS*

Quality does count in practically every electrical conduit installation that you make. When you use CONDULETS you know that you are putting in electrical equipment of the highest quality, because CONDULETS have been doubly tested . . . in the factory and in the field.

Crouse-Hinds quality control assures a long-lasting product and field records prove it by the test that only time can give. Thousands of CONDULET installations are still in tip-top condition after twenty, thirty, or even more than forty years of dependable service.

The illustration at the right shows four of Crouse-Hinds' basic quality features that are common to all CONDULETS. The fifth, Wedge Nut Fasteners, is an exclusive Crouse-Hinds feature that has made Obround CONDULETS preferred by electricians everywhere.

Type EVA Explosion-Proof Lighting Fixture

Type ARE Arktite Receptacle Equipment

Type FS Condulet With Pilot Lamp Receptacle, Switch and Plug Receptacle

Type GUAC Explosion-Proof Junction Condulet

1. **Taper tapping.** Condulet threads are taper tapped to match tapered conduit threading. Makes a rigid joint that will not loosen. This assures permanent ground continuity . . . important for safety.
2. **Integral bushing.** A smooth rounded surface protects wire insulation.
3. **Material.** Feraloy . . . a special alloy that is strong and tough, resists corrosion, and gives sharp, full threads
4. **Finish.** A triple treatment provides long-lasting protection . . . exceeds Federal and U. L. specifications.
5. **Wedge Nut cover fastener.** Clear cover opening . . . no projections. No loose parts . . . Wedge Nuts and screws self-retained. No screw holes to align.

More than 15000 items are listed in the Condulet Catalog including a complete explosion-proof and dust-tight line for use in hazardous locations.

On your next job, use CONDULETS . . . they're made right to last longer.

******CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.*

Type VC Vaportight Industrial Lighting Fixture

Type FLF Explosion-Proof Manual Motor Starting Switch Condulet

Type EPC Explosion-Proof Motor Starter and Circuit Breaker Condulet

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

A Nationwide Distribution Through Electrical Wholesalers

OFFICES: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee — Minneapolis — New Orleans — New York — Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle — St. Louis — Tulsa — Washington.
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Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

Generating capacity of this plant is now 260,000 kw. Output goes into transmission system at 115 kv or 230 kv.

How New Upper Midwest Power Plant Assures Uninterrupted Power for Station Auxiliaries

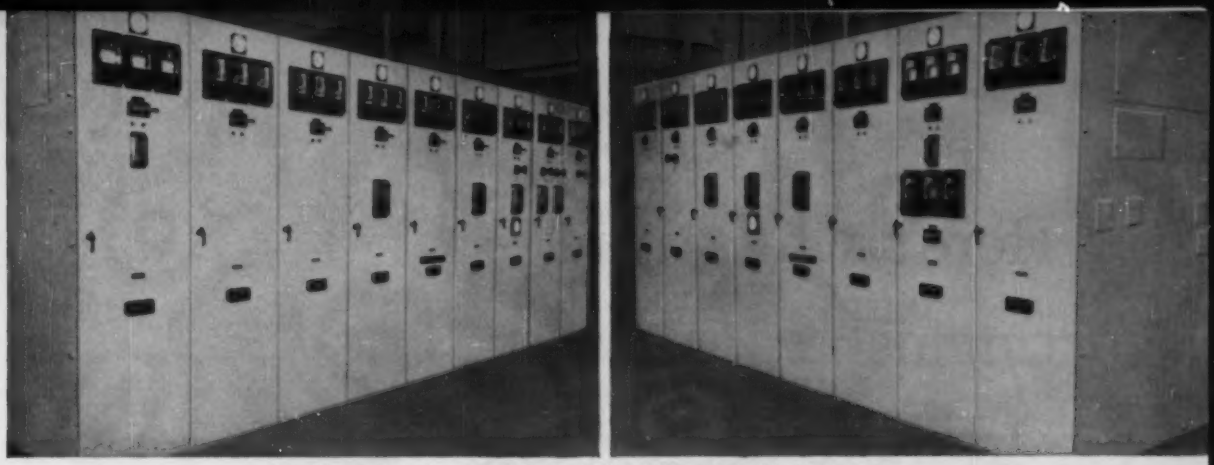
Installation Features Unit Auxiliary Buses in Two Sections With Automatic Emergency Transfer

Pioneer Service and Engineering Company in designing this plant decided on a manual make-before-break scheme on the throwover between the two sections of Allis-Chalmers switchgear. In this way they are sure the secondary source is cut in before cutting power from the primary source. A break-before-make automatic transfer is used in an emergency.

There is a house generator on the first unit only. It operates off the same shaft as the main generator, thus simplifying phasing problems. Operator is forced to use synchronizing switches, however, as a safety feature.

Auxiliary motors are protected by circuit breakers. To keep plant operating continuously, no overload

Progress In Switchgear **ALLIS-**



These two switchgear lineups face each other and are connected by bus shown at top. This group is one of three groups of Allis-Chalmers switchgear at this station.

tripping is used. An overload relay provides alarm on pulverizers and induced draft fan motors. Breakers trip only if there is a fault.

Two Switchgear Lineups

Two groups of Allis-Chalmers switchgear for each generating unit are provided along with duplicate auxiliaries. Each of these auxiliaries has excess capacity, so if one is shut down, the generating unit can still operate at two-thirds of full capacity.

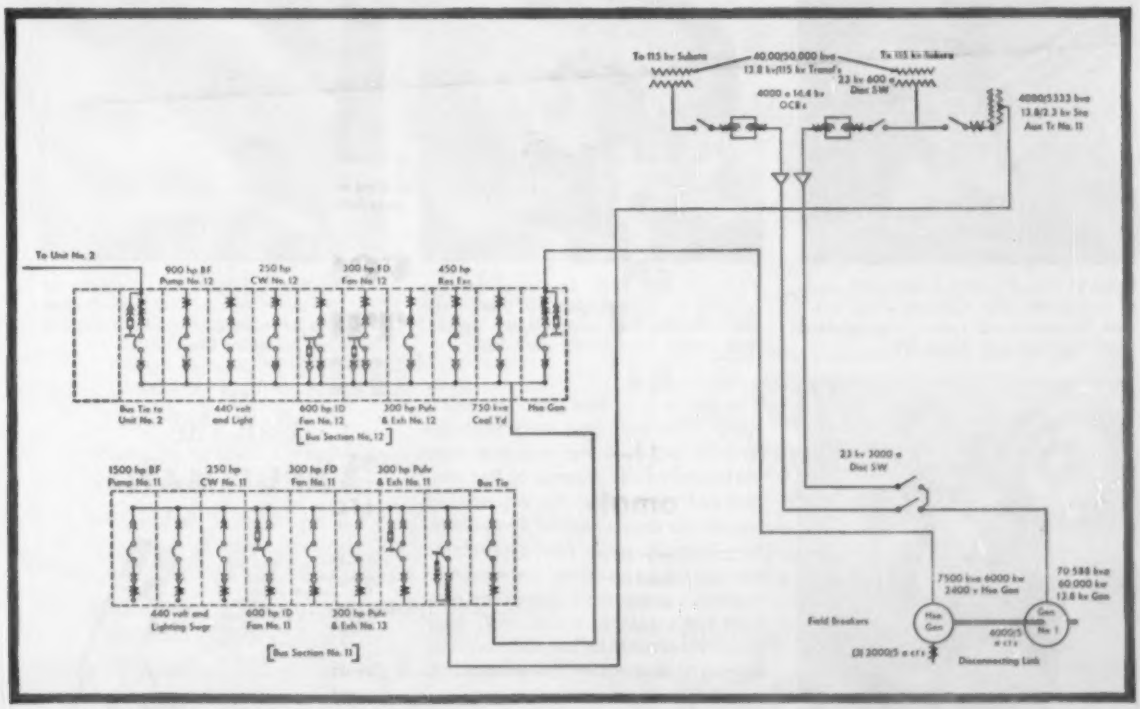
Both pulverized coal and natural gas can be used. These can be burned simultaneously in any desired proportion. This control is manual. Customary sequential interlocks in the switchgear are made with boiler control motors.

Both overload and short-circuit protection are provided by breakers on coal yard and miscellaneous circuits.

★ ★ ★

Allis-Chalmers engineers worked in close cooperation with Pioneer Service and Engineering Company and power company engineers on this interesting project. This is one of many auxiliary switchgear lineups built by Allis-Chalmers. For information, call your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4449



Engineered by Pioneer Service and Engineering Company.

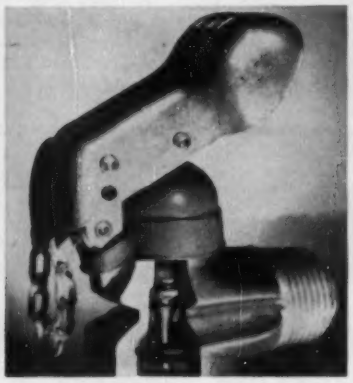
CHALMERS

A-C ALLIS-CHALMERS

Here's why Ansul extinguishers give you faster, more dependable fire protection!

READY for instant action under the most severe exposure conditions.

WEATHER-TIGHT NOZZLES made of aluminum and stainless steel, can't rust. Neoprene cap and oil-impregnated washers keep out moisture.



PUNCTURE PIN. In this aluminum housing a stainless steel pin pierces the gas cylinder that supplies the propellent power for the dry chemical.

PATENTED NOZZLES. Straight or fan stream, the hazard determines which is installed. An Ansul exclusive for more effective fire control.

FIELD RECHARGING. Just 4 minutes after a fire is extinguished your Ansul unit can be recharged, ready for action. No special tools are needed.

The pictures on this page tell half a story. The complete story includes Ansul's facilities for training your personnel in the science of fire control and prevention. Experience has taught us that *complete* fire protection demands *both*—fast, dependable equipment and trained personnel to man that equipment. Ansul can provide both. Get in touch with your local Ansul man, he has the complete story about *complete* fire protection.

Call the ANSUL MAN!

Get in touch with your local Ansul man through the "yellow pages," or write direct to ANSUL CHEMICAL COMPANY, Fire Equipment Division, Dept. F-151, Marinette, Wisconsin.

Write Ansul for your copy of New Fire Equipment Catalog.

ANSUL

Don Jenkins, Manager, and C. J. Burke, Gas Turbine Sales, go over a recent proposal recommending . . .

Low-cost relief for growing loads and older stations with the Westinghouse 5000-kw Gas Turbine Power Plant

This 5000-kw gas turbine, along with two others, is slated for tough, base load service in a remote area. These same units are also ideal for:

End-of-line, peaking and stand-by service.
Improving plant thermal efficiency in existing stations.

Westinghouse Gas Turbines have some very special advantages for these jobs . . .

- Complete, self-contained power plant. Quick and easy to install, requires less foundation and building than any other type of plant.
- Absolute minimum of personnel to operate and maintain . . . only one operator needed per shift.
- Can operate without cooling water, a tremendous remote site advantage.
- Boost capability . . . exhaust heat can be used to take extraction load off steam turbines, increase plant thermal efficiency and capacity at the same time.
- Proved reliability—meets every criteria for utility dependability.

It all adds up to one big factor. Properly applied, a Westinghouse Gas Turbine offers a low-cost method to increase capability. We're ready NOW to help you with complete facts and figures. Call your salesman or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50570

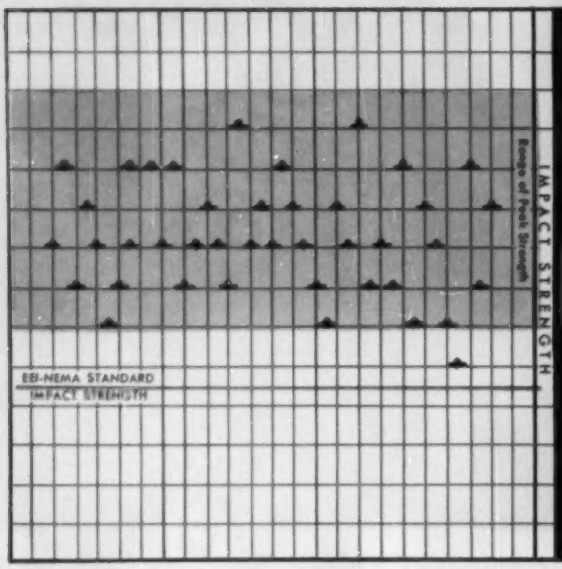
GAS TURBINE POWER PLANTS FOR ELECTRIC POWER GENERATION . . .

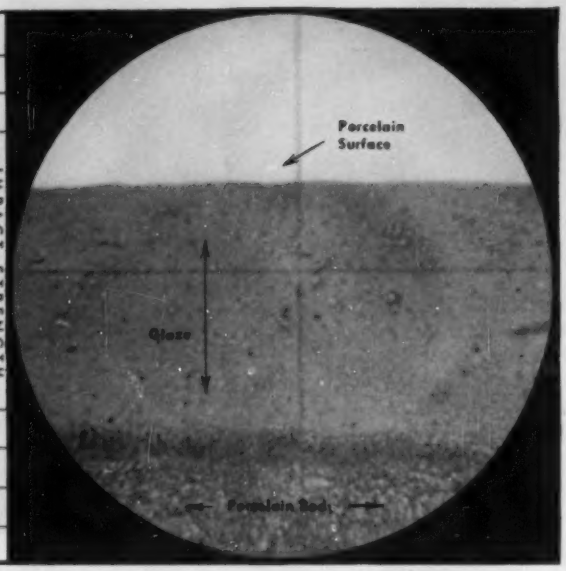
1250KW TO 15,000KW

YOU CAN BE SURE . . . IF IT'S

Westinghouse

6 Reasons Why Utilities Specify



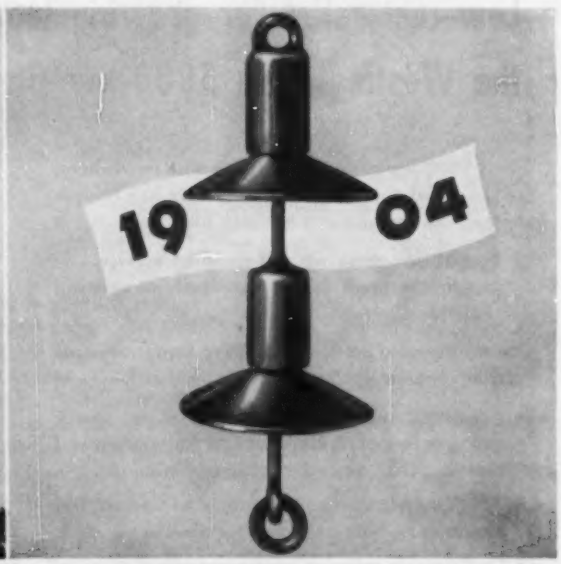


1. No Weak Sisters

AIEE standard tests show 98% of 10" MICRO-GLAZE® insulators tested fall within range of "peak impact strength." Representative industry samples tested were below this range.

2. Micro-control of Glaze Thickness

By precisely controlling glaze thickness (shown in photomicrograph of insulator surface section), Locke develops peak porcelain strength in production of suspension insulators.



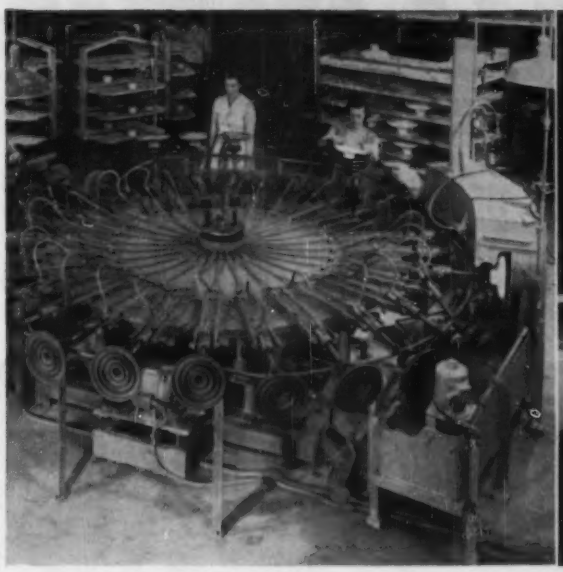
5. Less Chance of Damage

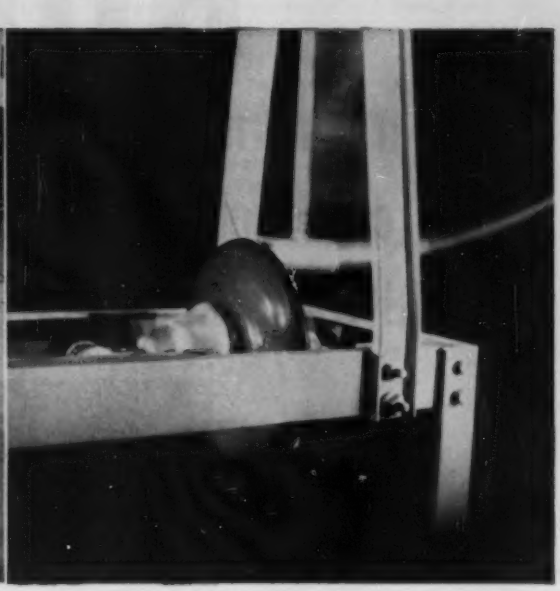
By installing Locke Microglaze® Suspension Insulators, utilities invest in extra protection against damage in transport and installation, as well as against malicious damage of transmission lines.

6. Half Century of Service

Since 1904 Locke suspension insulators have served dependably on power lines throughout the world. Half a century of outstanding product development stands behind Locke Microglaze® Suspension Insulators.

Locke MICROGLAZE Suspension Insulators





3. Precision Glazing

As insulators spin their way around this machine, they are cleaned, moistened, glazed exactly alike. With other controls, this assures uniform appearance, top strength, uniform reliability.

4. Highest Impact Resistance

Standard Impact Tests were pioneered by Locke. Hammer blows of increasing severity prove the standard impact rating is an understatement of the true strength of MICROGLAZE* suspension insulators.

Do as more utilities are doing every day--specify LOCKE Microglaze* Suspension Insulators

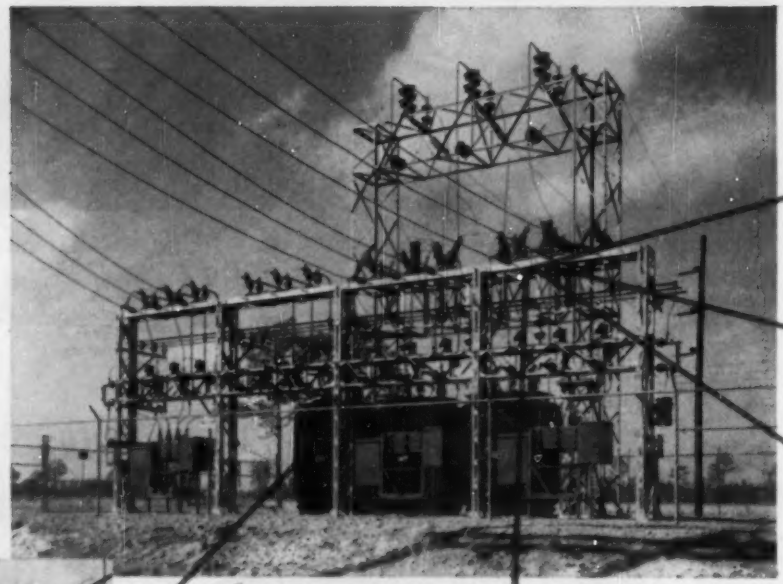
LOCKE

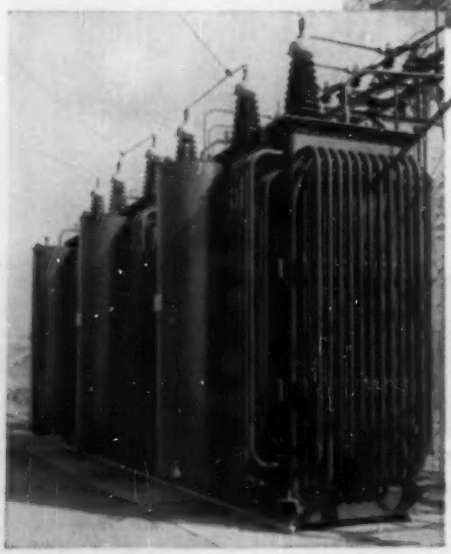
LOCKE DEPARTMENT
GENERAL ELECTRIC COMPANY
BALTIMORE, MARYLAND

*Trademark of General Electric Company

KUHLMAN

power transformers help insure uninterrupted service for continuous chemical processing operations of VIRGINIA-CAROLINA CHEMICAL CORPORATION



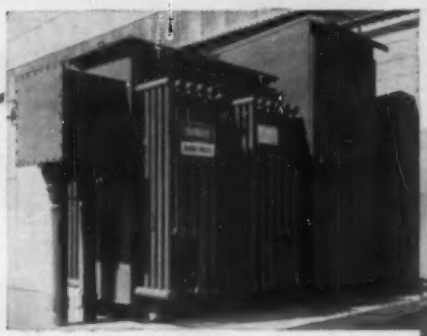


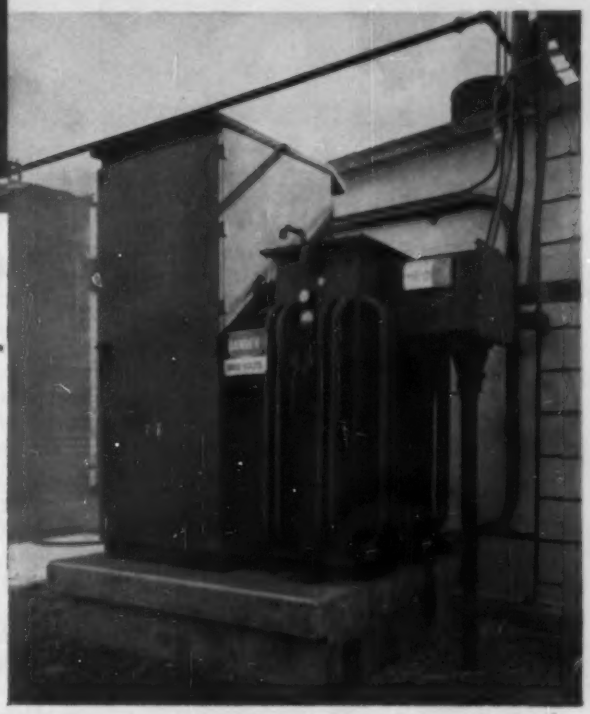
KUHLMAN

The new substation of Virginia-Carolina Chemical Corporation at Nichols, Florida, is served from a 69 KV transmission line and utilizes three KUHLMAN 2500 KVA, single phase, two winding outdoor power transformers with low voltage winding of 2400 volts. The high voltage is connected delta to the incoming line through protective fuses and metering equipment. The low voltage is connected 4160 volts wye, with the neutral grounded through a current limiting resistor. The 4160 volt feeders, each equipped with automatic reclosing oil circuit breakers and suitable breaker by-pass switches, are run to the processing plants.

At each of the new processing plants at Virginia-Carolina Chemical Corporation, a KUHLMAN unit-type outdoor substation of suitable capacity ranging from 300 to 1000 KVA reduces the voltage to 480 volts delta. This voltage is fed through a main air-circuit breaker, which is throat connected to the transformer, and then by enclosed bus into the building which houses the 480 volt control centers.

The phosphate mining and chemical processing operations of the Virginia-Carolina Chemical Corporation go on continuously, twenty-four hours a day, seven days a week, producing materials that are vital to national security. Since electricity is the principal source of power for these operations, when outages, due to electrical troubles, occur, production grinds to a virtual standstill and costs mount rapidly. To guard against such outages at the new processing plants and at the new substation that was built to serve these plants, Virginia-Carolina Chemical Corporation installed KUHLMAN Power Transformers exclusively. The reason: the Company's electrical engineers, production and maintenance men knew from experience that KUHLMAN Power Transformers would give the service reliability required. KUHLMAN Power Transformers are specifically engineered for the requirements of industries and utilities, providing extremely long life and low-cost maintenance as well as unusual reliability. For complete information, write us today.





159

ELECTRIC COMPANY

BAY CITY, MICHIGAN • CRYSTAL SPRINGS, MISSISSIPPI • SALINAS, CALIFORNIA

Service-Utility body lockers are triple-sealed against dirt and moisture. Doors are fitted with recessed handles, slam-action catches, and keyed-alike cylindrical locks for full protection. Ladder racks, vise brackets, and pipe supports also available. Factory-installed on nine models, three wheelbases, in GVW ratings from 4,200 to 8,600 lbs.

Cuts time on the job— saves money all around !

An INTERNATIONAL Truck with Service-Utility body is the world's finest time and money-saver for everyone who has to take tools, parts, or equipment from shop to job.

The Service-Utility body provides all-steel lockers, with compartments of varying sizes, for orderly storage and convenient use of every needed item — eliminates the costly mileage and wage expense caused by unnecessary job-to-shop trips.

And INTERNATIONAL Truck quality further lowers costs. Famous INTERNATIONAL engines assure top performance with maximum economy. INTERNATIONAL Tough-Job engineering and all-truck design mean utmost dependability, long life, and lowest maintenance expense.

Plus all this you can have greater driver comfort, greater performance and economy with newest INTERNATIONAL features. Overdrive transmission is a low-cost option on these models. And all light-duty models are available with new automatic transmission and power steering at low extra cost.

Ask your INTERNATIONAL Dealer or Branch for complete details on these time-saving, cost-cutting trucks — today!

INTERNATIONAL HARVESTER COMPANY • CHICAGO

International Harvester Builds McCORMICK® Farm Equipment and FARMALL® Tractors...Motor Trucks...Industrial Power...Refrigerators and Freezers

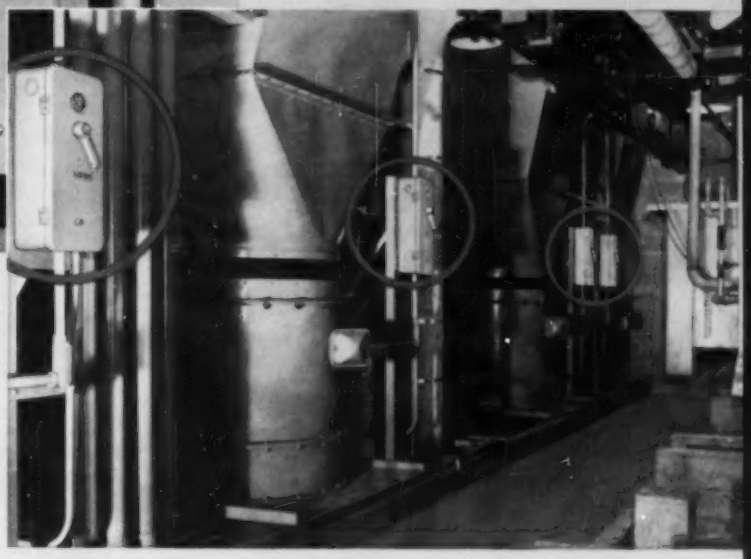
See the season's new TV hit, "The Halls of Ivy," with Ronald Colman and Benita Hume, Tuesdays, CBS-TV, 8:30 p.m., EST

INTERNATIONAL TRUCKS

"Standard of the Highway"

A neat, compact line-up of Allen-Bradley Bulletin 712 combination starters in the control room of a large chemical processing plant. Starters can be padlocked in "OFF" position.

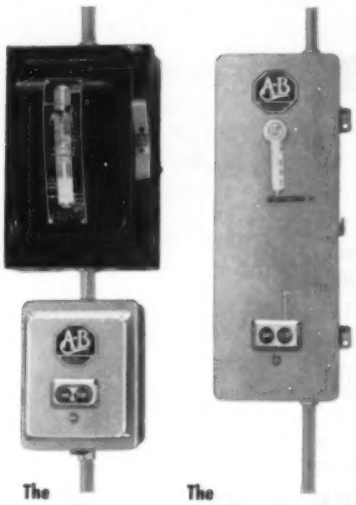
A row of Allen-Bradley Bulletin 712 combination starters in metal finishing plant. Note the simplified wiring which is possible when disconnect unit is in same enclosure with starter.



ALLEN-BRADLEY COMBINATION STARTERS

Save wiring costs
Save Space

Assure safer and neater motor controls



The OLD Way

Separate disconnect mounted above and wired to motor starter. Difficult to do a neat appearing wiring job.

The MODERN Way

Bulletin 712 combination starter with disconnect. Cannot be opened unless disconnect lever is "OFF."

STREAMLINE your MOTOR CONTROLS

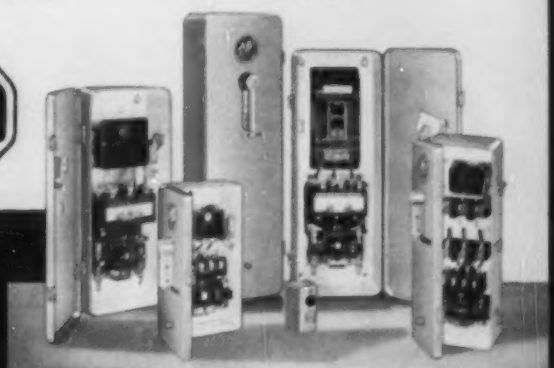
by using A-B Combination Starters

The Allen-Bradley line of combination starters is available in two general types—Bulletin 712 with manual disconnect switch and Bulletin 713 with automatic I-T-E circuit breaker. In addition to the standard NEMA Type 1 pressed steel enclosure, these combination starters are furnished in watertight, dust-tight, and semidust-tight enclosures, as well as in enclosures for hazardous gas and dust locations. For complete information, please write for the Allen-Bradley 120-page Handy Catalog.

Allen-Bradley Co.
1316 S. Second St.
Milwaukee 4, Wis.

•

In Canada—
Allen-Bradley Canada Ltd.
Galt, Ontario



Allen-Bradley Combination Starters

1-55-M

ALLEN-BRADLEY
COMBINATION STARTERS
QUALITY

DRUM SWITCHES

Bulletin 365 MULTISPEED DRUM SWITCHES for 2, 3, and 4 speed motors.

Bulletin 806 DRUM SWITCHES for pilot control and transfer switch service.

Open View of Bulletin 350 Drum Reversing Switch on Worthington welding positioner. Available up to 20 hp, 220 v; 40 hp, 440-550 v. For d-c motors up to 3 hp, 115-230 v.

MANUAL CONTROLS

for Alternating & Direct Current Motors

There are many types of motor-driven machines for which a simple drum switch is the most suitable type of manual control. For such applications the Allen-Bradley line offers a wide variety of types and sizes of drum controllers up to 300 hp, 220 v; 500 hp, 440-550 v.

Practically any combination of switching operations can be arranged by the proper combination of drum segments and contact fingers. For complete information on Allen-Bradley drum controllers, send for the 120-page Allen-Bradley Handy Catalog.

Allen-Bradley Co.
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In Canada—
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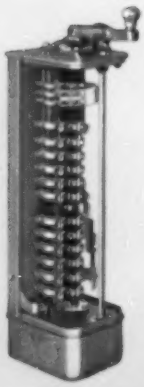
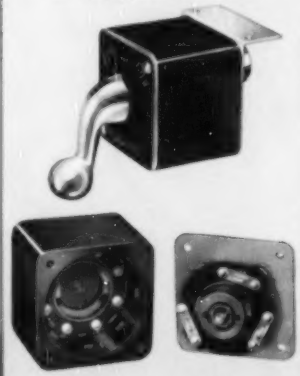
Galt, Ontario



Bulletin 375-385 DRUM SWITCHES for polyphase, wound rotor induction motors.

Bulletin 350 Low Cost STYLE A DRUM SWITCHES for polyphase motors up to 1½ hp, 110 v; 2 hp, 220-440-550 v.



For Single Phase Motors up to 1 hp, 110 v; 1½ hp, 220 v. D-C motors— ¼ hp, 110-220 v.

ALLEN-BRADLEY
QUALITY
MOTOR CONTROL

1-55-M

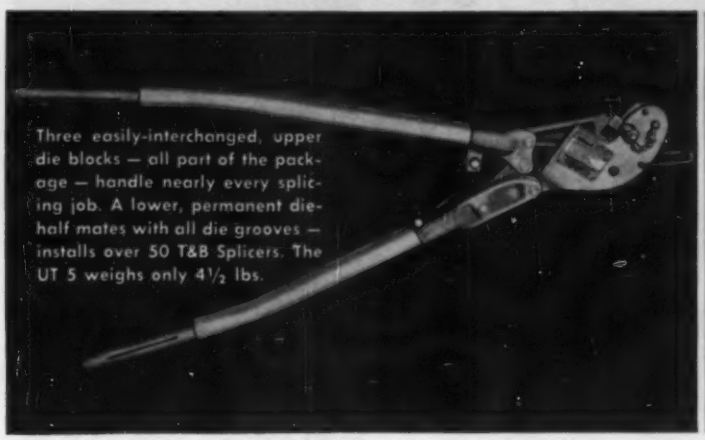
T&B's COMPLETE SPLICING PACKAGE *for*

COPPER
Solid and Stranded
#8 stranded to #2 stranded

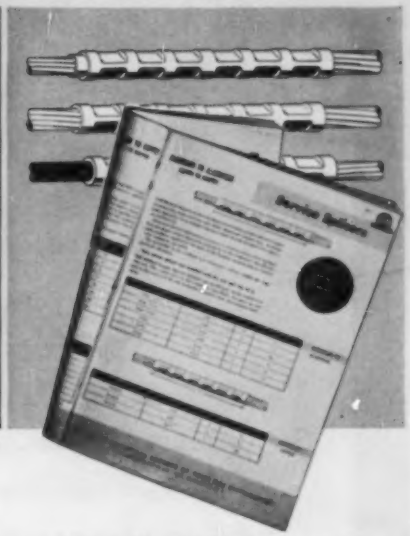
ALUMINUM
Solid and Stranded
#6 solid to 2/0 stranded

A.C.S.R.
#6 (6x1) to 1/0 (6x1)

THE UT 5 INSTALLING TOOL...AND THE SPLICERS



Three easily-interchanged, upper die blocks — all part of the package — handle nearly every splicing job. A lower, permanent die-half mates with all die grooves — installs over 50 T&B Splicers. The UT 5 weighs only 4½ lbs.



One UT 5 Installing Tool is all that's needed to splice a wide range of service and distribution conductors. Switch to T&B and use *one* tool instead of many; slash tool costs and inventories to a minimum.

High mechanical advantage of the UT 5 tool minimizes manual effort required to make strong, electrically efficient splices. Hardened steel dies force splicer and conductor into a *square*-sectioned, homogeneous mass. Compound lower die design provides a high-unit-pressure area for installing the steel core of A.C.S.R. Dies are easily changed by loosening a single thumb screw. No tools required. Die grooves and connectors are conveniently letter-coded to assure proper die selection.

Let your T&B Distributor demonstrate the UT 5 and its many advantages . . . see how one UT 5 does the work of a dozen or more tools.

T&B Bulletin 71 gives the full story on the UT 5 Installing Tool and the wide range of T&B Splicers that it will install. Send for your *free* copy today.

LOOK FOR THIS SIGN —

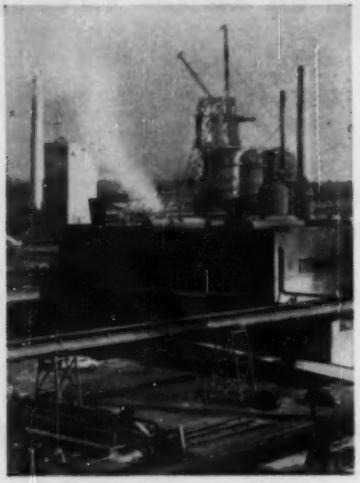
IT'S THE MARK OF AN AUTHORIZED T & B DISTRIBUTOR
The complete line of T & B fittings for conductors and raceways is sold only by recognized electrical wholesalers. It's our way of assuring you the service and savings of a friendly local source. Call him for all your electrical needs. T-425

THE THOMAS & BETTS CO.
INCORPORATED
14 Butler Street • Elizabeth 1, New Jersey
Thomas & Betts Ltd., Montreal, P.Q., Canada
MANUFACTURERS OF QUALITY ELECTRICAL FITTINGS SINCE 1898

...before you leap

A careful look by Kaiser Engineers often results in departure from traditional methods in developing plant designs that anticipate the client's needs for future expansion and improvements. Numerous examples of this type of cost-saving engineering foresight are to be found in work performed by Kaiser Engineers in the broad fields of industrial design and construction.

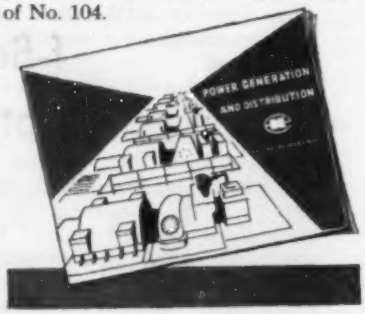
Capsule Case History:



To Make More Steel You Need More Steam

and in this rapidly growing steel plant, engineering foresight provided the needed expansion with both downtime and costs kept at a minimum. When a fourth 160,000 lb/hr boiler was installed, foundations and utilities were laid anticipating a fifth. This boiler was later installed with resultant savings for the operators. With Kaiser Engineers, provision for expansion is a standard approach.

A new power brochure, outlining Kaiser Engineers' experience in generation and distribution, will soon be published. Write today for your copy of No. 104.



kaiser | engineers ...for low operating costs

DIVISION OF | HENRY J. KAISER COMPANY

ENGINEERS K CONTRACTORS

• HOME OFFICE: KAISER BUILDING, OAKLAND 12, CALIFORNIA (CABLE: KAISENGS) NEW YORK, PITTSBURGH, LOS ANGELES, WASHINGTON, D. C.
• HENRY J. KAISER CONSTRUCTION CO. • HENRY J. KAISER COMPANY (Canada) LTD., MONTREAL

New loss-of-field relay provides automatic protection of machine and system

When a synchronous machine loses its field, both the machine and system stability are seriously threatened. Low excitation can lead directly to thermal damage of the machine. In addition, the machine may go out of synchronism and draw sufficient reactive power from the system to upset system stability.

The new Westinghouse HLF relay protects both the machine and system. When low field conditions cause the machine to exceed its capability, an alarm is immediately sounded. Warned in time, the operator can take corrective measures without taking the machine off the line.

Should the system voltage drop to a point threatening system stability, a self-contained voltage element in the relay will immediately trip the machine.

All relay components are coordinated to prevent false tripping in event of low-voltage conditions alone, or external faults. The relay is adaptable to all types of synchronous machines without modification.

For the best in relays, rely on Westinghouse leadership in relay engineering. Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-40463

YOU CAN BE **SURE**...IF IT'S

Westinghouse

WITH A KIDDE CO_2 SYSTEM!

Let fire get a foothold, and a going concern is *gone*. Don't risk it. Install a Kidde Automatic CO_2 Fire Extinguishing System, and fire won't stand a chance.

A Kidde System goes into action at the first sign of fire—releases clouds of CO_2 over the blaze, smothers fire almost as soon as it starts. And CO_2 leaves no mess to clean up later. It puts out the fire, then vanishes.

Protect motors, generators, switch gear—all electrical equipment with a Kidde System.

And for on-the-spot protection, get Kidde portables. When fire strikes, just aim the horn, pull the trigger, and *swoosh!* No more fire.

Don't wait 'til your business is a cinder pile—Contact Kidde today.

Kidde

The words 'Kidde', 'Lux', 'Lux-O-Matic' 'Fyre-Freez' and the Kidde seal are trademarks of Walter Kidde & Company, Inc.

Walter Kidde & Company, Inc.
130 Main Street, Belleville 9, New Jersey
Walter Kidde & Company of Canada, Ltd., Montreal—Toronto

Has your 2-Way Radio system reached retirement age?

FORGET about how long you've operated one mobile communication system. Years aren't important. The *actual* age is measured by looking at yesterday's use. Look for abnormal road shock . . . severe weather exposure . . . day-in and day-out service because you *had* to work extra hours. Any or all of these conditions may have earmarked your 2-way radio equipment for an early grave. Find out too, if the system you are now using is adequate by today's standards. Will it meet the greatly expanded service needs of your industry?

Electric utilities show an amazing growth during the past seven years. Compared with 1947, kwhr demand has increased 75% bringing service to 11.5 million new customers. And, radio installations have *not* kept pace with this expansion.

Find out the true value of your mobile communications today. If the system is sub-standard for any reason then be sure to compare these features on all new equipment: Initial expense . . . dependable performance *at all times* . . . long-life and *particularly* maintenance cost. The final score on this type of comparison will always show why General Electric 2-way radio is preferred.

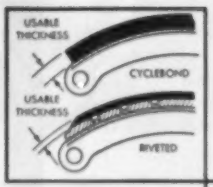
2-WAY MOBILE RADIO

FREQUENCY STABILITY & SELECTIVITY
guaranteed for life!

A G-E COMMUNICATIONS COUNSELOR will provide valuable assistance in this program as well as on all communication problems. Call him at a local office or write us today: *General Electric Company, Section X1915-10, Communications Equipment, Electronics Park, Syracuse, New York.*

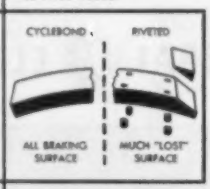
GENERAL ELECTRIC

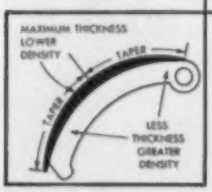
Another typical example of Dodge truck's extra-value engineering



More usable thickness.
Dodge truck Cyclebond brake linings can be used virtually through their full thickness. This gives the linings many thousands of miles of added life. Riveted linings should be worn only to rivet heads.

More usable surface.
Every square inch of Cyclebond lining area is braking surface. Riveted linings, because of rivet holes and mitered ends, have up to 10% less braking surface.





Tapered for easy stops.
Cyclebond lining is more tightly compressed at ends, gives a gradual taper. Thick center of lining makes first contact...increased pressure brings the ends into contact. Braking is smooth, even.

Why you go more miles before relining with Dodge truck brakes!

You can be sure of lower brake maintenance, more miles before relining, with Dodge truck brakes and famous Dodge truck Cyclebond linings. And that's in addition to the quick, positive stops, the smooth action, for which Dodge truck brakes are famous.

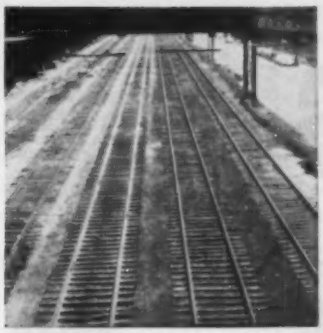
Long-lasting, reliable brakes are just one example of the extra-value engineering that means more for your money when you buy . . . more money saved over the life of your truck. Get the facts on how extra-value engineering saves you money; see your dependable Dodge Truck dealer.

DODGE "Job-Rated" TRUCKS

A PRODUCT OF CHRYSLER CORPORATION

Weed and Brush Control lasts longer with Du Pont TELVAR® and AMMATE®

Weed Killers — **Weed and Brush Killer**



"Telvar" has kept this yard clean of vegetation for two years.

Note thorough job "Telvar" did around this fence. "Telvar" won't corrode fence or equipment; it's non-flammable, non-volatile.

Heavy weed growth around pole was controlled with one application of "Telvar." It's easily applied and extremely low in toxicity to humans and animals.

One application of "Telvar" solves weed problems for a season or longer!

"Telvar" kills through the roots . . . prevents regrowth. Low dosages (20 to 80 lbs. per acre) make it cost little for the results you obtain. Low rates also mean less handling, less storage facilities. If you're looking for a way to cut maintenance costs to new low levels, include "Telvar" in your weed-control program. Available in two formulations: "Telvar" W; and "Telvar" DW, which is especially suited for light, sandy soils and in areas where annual rainfall is higher than 20 inches.

"Ammate" kills more kinds of brush and keeps it down longer than most weed and brush killers!

When the original spray job is well done, brush is kept under control with nothing more than an occasional spot spray later. You can rely on "Ammate" to do the job safely, even where your rights-of-way adjoin crop land, because "Ammate" is not volatile. There are no vapors to drift onto sensitive crops.

FREE ILLUSTRATED BOOKLETS describe how to control weeds and brush with Du Pont chemicals. For your copies, write to Du Pont, Grasselli Chemicals Dept., Rm. D 4038, Wilmington, Del. In Canada—Du Pont Company of Canada Limited, Montreal, Box 660, Canada.

TELVAR® Weed Killers — **AMMATE®** Weed and Brush Killer

On all chemicals always follow directions for application. Where warning or caution statements on use of product are given, read them carefully.

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

"Ammate," applied five years ago, is still keeping brush down along this right-of-way.

Maintenance crews prefer "Ammate" because they can use it without hazard to themselves, livestock, wildlife or adjoining crops.

Same right-of-way as above, three years after treatment. Brush still under control; low-growing cover returned to resist erosion.

kerite acknowledges

with thanks the good wishes received during
the celebration of our 100th anniversary.
We have been privileged to form many
lasting associations over the past century
and hope to merit their continuance.

Now, on the threshhold of a second century,
we pledge a continuance of the same vigorous pioneering spirit
that produced Kerite insulation and the many
original developments which have protected its integrity
and extended its application.

KERITE CABLE

THE KERITE COMPANY—30 Church St., New York 7, N. Y.
Offices also at 122 S. Michigan Ave., Chicago; 582 Market St., San Francisco;
3901 San Fernando Rd., Glendale 4, Calif.; 31 St. James Ave., Boston

Are You Ready for a Heat Storm?

Adversity tests the stamina of an engineer—and of his distribution system. Striking this time in the guise of a protracted heat wave, it proved that air conditioning can boost electrical loads far beyond expectations. Despite generous provision for predictable demands, distribution systems suffered costly damage. And utility personnel toiled long hours under intolerable conditions to lessen the discomfort of their customers.

Afflicted utilities have earned the commendation of the entire industry for their valiant battle. They absorbed the staggering cost of reinforcing faltering distribution, hired contractors to supplement the all-out efforts of their own crews and engineers, depleted transformer stocks. Their engineers, despite the stress of urgency, devised ingenious methods to alleviate destructive loading and falling voltage. They used to fullest advantage the material at their disposal. In short, these utilities and their personnel stretched every resource to combat this emergency.

Nature's heat is off now, but the struggle continues. This issue is replete with reviews of the last two summers' battles and of preparations for the next. And in these on-the-spot reports is a warning to every utility to survey its own bulwarks before they suffer assault. These questions might well start the survey:

1. Has your distribution enough margin to stand up under double or triple the year's expected load growth?

2. Is your testing really adequate to determine load and voltage conditions accurately?

3. Are your records in shape to interpret conditions and expedite extensive reinforcements at emergency speed?

4. Have you enough manpower trained and equipped to cope with such an emergency?

5. Are your normal stocks of distribution equipment adequate?

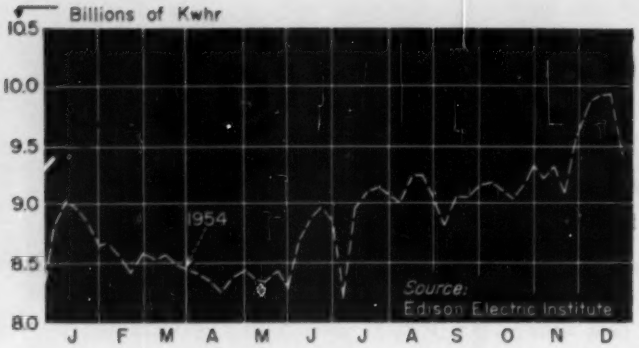
6. Would your public relations stand up during prolonged or widespread disruption of service?

Money spent in emergency is never as productive as the same amount spent on well-planned system improvements. And replacing equipment destroyed by service abuse is usually a total loss at premium rates. Any opportunity to avoid these wasteful expenditures by intelligent preparation merits closest scrutiny and appropriate action.

No utility can afford to luxuriate in supposed exemption from nature's blows. These victims suffered heat that baked transformers beyond endurance. Eastern companies sprawled in the paths of destructive hurricanes. Others may yet face devastating ice and snow. But so varied and unpredictable are the manifestations of nature's power that no company dares remain unprepared.

THE ELECTRICAL WEEK

LAST MINUTE



Week Ended Jan 1

9,425,000,000 Kwhr

Up 15%

Per Cent Change from Previous Year

	US Total	Eng. New	Atlan. Mid.	Ind. Cent.	Cent. West	east South-	Cent. South	Mount. Rocky	NW Pacific	SW
Jan. 1	+15.0	not available								
Dec. 25	+15.4	+12.3	+9.1	+15.0	+6.2	+25.0	+11.8	+9.4	+11.8	+11.2
Dec. 18	+11.4	+6.0	+5.1	+8.7	+4.3	+19.9	+11.4	+12.2	+11.6	+7.5

Seasonally Adjusted Index —177.7 Week Ago 177.1 Year Ago 159.4

The Issue's News Highlights . . . Consolidated Edison Co has asked for bids for a 200-Mw atomic power plant it proposes to build entirely at its own expense . . . New York State Power Authority outlines its plans for development of more power at Niagara . . . Commonwealth Edison issues statement on accident at Ridgeland Station . . . TVA reports that it needs more generating capacity promptly to avoid a power shortage in the valley . . . AEC data show its power usage is growing rapidly.

Nuclear power will not drive other fuels out of the market because "America's demands for power are insatiable," according to Lt Gen Leslie R. Groves, Remington Rand vice president and former head of Manhattan Project. He told New York Security Analysts atomic power development will come because other fuels are going up in cost and atomic costs are coming down. He sees nuclear power plants of 500,000 to 1 million kw, "since operating costs will not be much higher for large plants."

North Carolina Utilities Commission has put New Bern's municipal power plant on notice to improve its service to citizens of Havelock community or lose these customers to Carolina P&L. Citizens petitioned commission to order CP&L to furnish service to them because of inadequacy of municipal service. Commission notes evidence tends to support charges of petitioners that CP&L can furnish adequate service at lower rates than citizens are now paying for "very poor service" and gives New Bern until April to improve its service or face commission action.

Early construction budgets augur well for coming year. Consolidated Gas EL&P of Baltimore plans record $35 million this year, up $7 million from 1954. Pres Charles P. Crane notes that residential electric load growth during past five years has been 82%, and in 1954 alone it was 12%. New England Electric System will spend $50 million this year compared with $43 million last year, and Pres Irwin L. Moore looks for revenue increase of 5-6% and a kwhr sales increase of about 7%.

Union Electric Co of Missouri plans $4.5-million improvement in its distribution system to meet next summer's air conditioning demands. Over and above company's regular construction expenditures, program will enlarge transformer capacity at 6,000 locations in St. Louis and outlying districts. In another announcement company says it is withdrawing from retail sales and repair of electrical appliances and will concentrate on sales promotion on behalf of dealers and distributors.

NEWS OF THE INDUSTRY BRIEFLY TOLD

Off the Washington Wire . . . REA Administrator Ancher Nelsen spiked three rumors last week: That REA would increase interest rates this year, that REA would be pulled out of Agriculture Department and placed under control of Presidentially appointed farm credit administration type of agency, that recent order banning loans to co-ops which "check off" dues applies to co-ops which are members of NRECA.

Reorganization of Interior's power agencies has been approved at top level. New personnel charts have been reviewed, and job of whittling down personnel is still going on . . . No settlement has been reached yet on marketing of Clark Hill Dam power . . . Hoover Commission's task force report on water and power resources will be completed in February. No findings have yet been made.

Cleveland Electric Illuminating will recommend to stockholders at April 26 annual meeting that company's stock be split 2-for-1 with par value set at $15 a share. Pres Elmer Lindseth says proposal is intended to "widen market for our common stock and further encourage stock ownership among our employees and customers."

New York's Gov. Averell Harriman urges a "determined effort to persuade Congress" to reject plan of the five electric companies to redevelop Niagara power. In message to legislature he says these companies are seeking to "seize the state's water power" by federal legislation. Harriman adds state Power Authority would develop Niagara "for benefit of consumers" and "not benefit of the five utility companies."

General Electric will begin construction this spring at Hickory, N. C., on a $20-million distribution transformer plant with 400,000 sq ft of space. Completion is scheduled for late 1956. Company also changes discount structure in prices for polyphase motors in 1-200-hp range, thus reducing charges about 6%.

AEC has slipped, apparently, in listing its electric power sources. For the first time it has disclosed that it is getting power from the 50-Mw Dana plant of Public Service Co of Indiana (see listing on p 56 of this issue). The Dana AEC installation is classified.

ABOUT PEOPLE IN THE INDUSTRY

Alternative to partnership program is "stagnation" and "socialism," Interior Secretary Douglas McKay tells Salem, Ore., Chamber of Commerce. "We don't plan," he adds, "to reduce our people to dependency on Washington because a few vocal left wingers and self-proclaimed intellectuals deny the lessons of history."

Yankee Atomic Electric is thinking of "a project that would run into the millions of dollars, perhaps something in excess of $20 million," Pres Irwin L. Moore tells Massachusetts Department of Public Utilities in seeking approval to issue $317,500 of $100 par stock. Yankee Atomic is first of such industry groups seeking commission approval to issue stock for cooperative atomic development.

More News About People page 164

Con Edison Asks Bids on Privately Financed 200-Mw Atomic Plant

JAMES F. FAIRMAN, vice president of engineering

News that the electric utility industry has taken a new and giant stride in the direction of putting atomic power on a fully competitive commercial basis came last week with the disclosure that Consolidated Edison Co of New York has gone into the open market to obtain bids and proposals for a 200-Mw atomic power plant that it proposes to build entirely at its own expense.

The giant New York utility has approached the proposed atomic power project in much the same manner that it would tackle the addition of a new conventional fuel-fired plant. Its first step was to call in the pioneer manufacturers of atomic power equipment and ask them to submit designs and costs for a 200-Mw installation.

"With the change in the atomic power act, we decided that we had received some sort of green light to investigate the feasibility of developing commercial atomic power," James F. Fairman, Con Edison's vice president of engineering, said last week in interpreting his company's action.

The company felt, Fairman said, that it had an obligation to examine the prospects of atomic energy seriously. "We wanted to start off on a free enterprise basis because we are convinced that this is the way atomic energy will ultimately be sold," he said. "All we want from the federal government is to lease fuel from it."

In getting into the atomic energy game on its own, Fairman said, Con Edison decided to use the traditional utility approach of letting manufacturers do the research, development and proposing. "So we turned to General Electric Co and Westinghouse Electric Corp and said in effect 'We have clipped your coupon . . . what do you have to offer?' "

Basically Con Edison needs the answers to two questions, Fairman said: "What can we do quick—that won't take ten years of research, and that isn't so uneconomical that we cannot afford it?"

To help them in analyzing these problems Con Edison has retained Vitro Corp of America, another veteran of AEC projects. Also since making its offer to the two companies mentioned above, Con Edison has received a request from the Babcock & Wilcox Co to bid on the reactor part of the plant only.

Fairman and his associates, however, won't be surprised if bids run close to $300 to $350 per kw for the plant. Fairman feels it's virtually certain, that the larger the atomic unit, the better will be its chances of producing power economically. "We picked about 200 Mw for the proposed project as it is the right order of magnitude for our system. It would be silly to put a smaller unit on this kind of system," he said.

While Edison engineers did not make any specification regarding engineering features of the plant, Fairman said they did offer one suggestion. That was that suppliers explore the use of a separately (fuel) fired superheater to secure better temperature conditions for the steam pressure being produced by the reactor. This would improve the steam conditions and allow use of a turbine designed along conventional lines that should cost less than a machine tailored to the use of saturated steam.

Con Edison hopes to apply the same approach to the purchase of atomic fuel that it uses in buying conventional fuels, Fairman said. The company would much prefer to lease such fuel on an overall net heat basis paying a certain number of cents per million BTU used, returning the unburned fuel and waste. Con Edison, he said, does not want to tackle the waste disposal problem.

What this fuel cost will be and the form of the contract will have to be worked out with the Atomic Energy Commission, Fairman said. Whether Con Edison finally decides to build the plant, Fairman said, depends on how close the net cost of producing energy comes to meeting Edison's present production costs. If by good luck the net cost per kwhr is a few mills more than what we are now getting and if the reactor gives good promise of being increased in capacity or efficiency with advances in the art, —then we will make application for permission to build the plant, Fairman said.

The recently purchased Indian Point property on the Hudson River south of Peekskill, N. Y., will probably be the location of the plant. However, this site must of course be approved by the AEC's Reactor Safety Committee, Fairman pointed out.

New York Charts Its Plan for Niagara

New York State Power Authority Chairman Robert Moses late last month outlined a program for developing 1,240,000 kw of power from Niagara Falls. He estimated state development would result in power costs of 2.88 mills a kwhr.

The state's plan for Niagara development also includes parkway and park facilities by the river. Overall cost would be $405 million.

Attack on Private Utilities . . . In disclosing the authority's latest plans for obtaining additional power from Niagara, Moses continued his attack on the five private utilities in New York also seeking authority to develop Niagara power. He contended private utilities had been guilty of 75 years of "exploitation" of Niagara Falls.

Moses also deplored the fact that the dispute on the American side of the river has held up utilization of the additional water from Niagara while Canada is now benefiting from new facilities using its share of the water.

The sharp-tongued Moses emphasized that the state would not allow its great natural resources to be turned over to five private utilities who he said wanted to make a "killing." He vowed a court fight even if it tied up addition power for 20 or 30 years.

Earle J. Machold, president of Niagara Mohawk Power Corp, made this statement:

"We have not seen the engineers' report containing the State Power Authority's plans for the Niagara Falls Power Project. As reported in the press, it is only a restatement of the position which the New York State Power Authority has taken for the last several years. It is also a restatement of the 1949 plan of development, as to which there never has been any controversy.

"The Congress must decide whether the development is to be a tax-free governmental undertaking or shall be undertaken by taxpaying private enterprise.

"We shall continue our efforts to be authorized to complete the power development at Niagara by private enterprise."

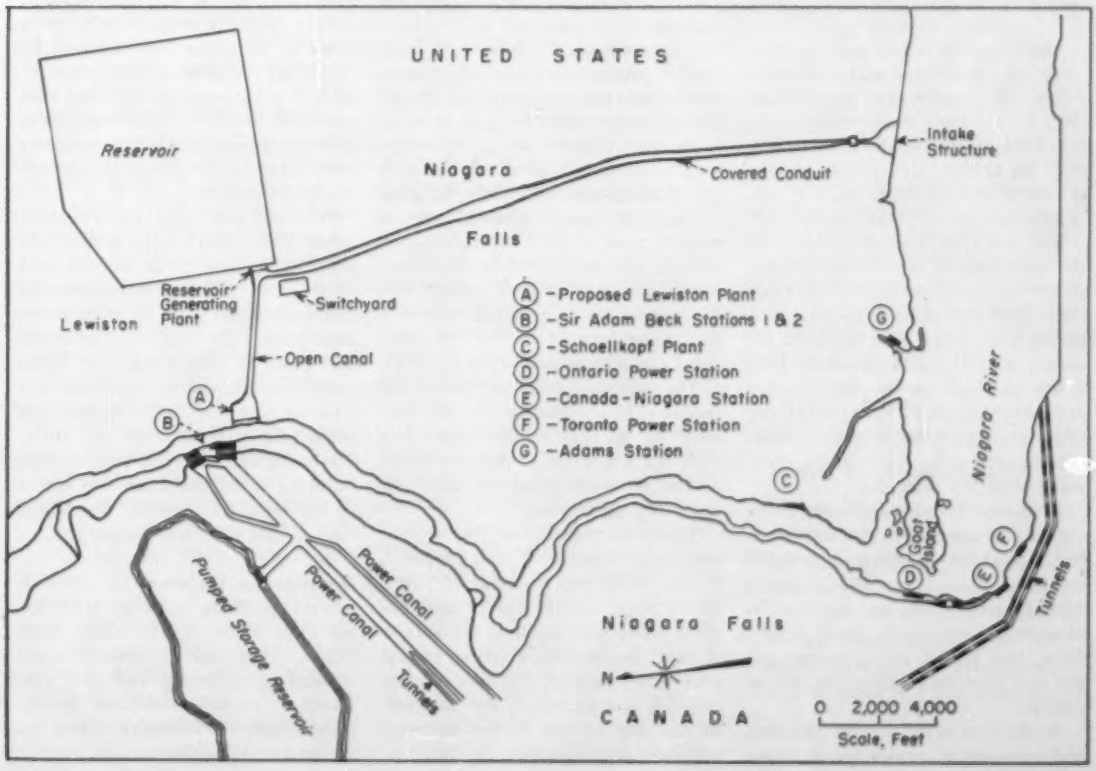
The main engineering points of the authority's plan are these:

1. Construction of main power plant at Lewiston. Plant would have ten 150,000-kw generators.

2. Construction of a pumping-generating plant, with an artificially constructed storage reservoir. Pumping plant would have six generator-motor units rated at 20,000 kw as generators, using 28,000 kw as motors.

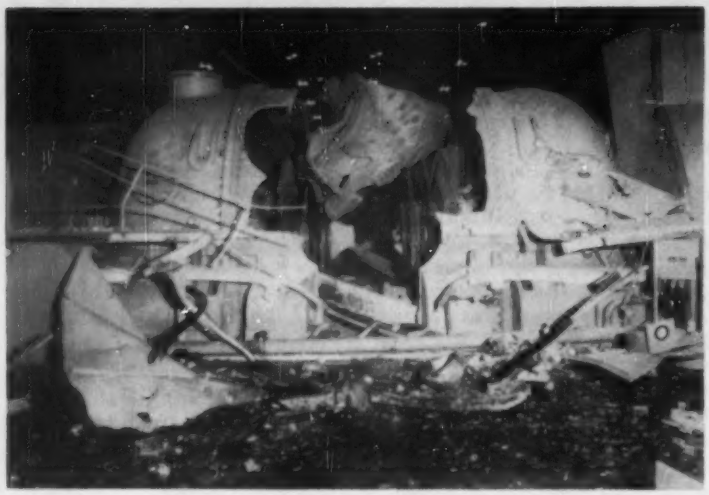
3. Utilization of covered conduit water passages between the intake and the forebay of the pumping plant. Water will be carried from forebay of the pumping plant to main generating plant by open canal.

NEW YORK POWER AUTHORITY plan for developing power at Niagara includes power plant, pumping plant, and reservoir at Lewiston



Report on Ridgeland Accident

Following are excerpts from a statement by Commonwealth Edison to the trade press. It is a summary of the situation before and after the accident which destroyed a turbine and damaged generating equipment at Ridgeland.



LOOKING east in turbine room, photo shows shattered housing and broken spindle of turbine

The low pressure turbine of a cross-compound generating unit with a capability of 160,000 kw exploded on Dec. 19, 1954 at Commonwealth Edison Co's Ridgeland Station, apparently due to metal failure in the turbine spindle shaft. The basic cause of this failure has not yet been determined.

The unit (No. 4) is one of four of the same size in this station. Flying pieces of metal damaged the other three units and the station was completely shut down. The accident occurred at 11:19 P.M. Sunday. Unit 2 was put back on the line Tuesday at 12:43 P.M., Unit 1 at 5:34 P.M. the same day, and Unit 3 at 1:20 A.M. Wednesday. All three units were restored within 50 hours.

Ridgeland Station is the newest on the Edison system . . . Its four units had a total net capability of 640,000 kw. Unit 4, built by Allis-Chalmers Manufacturing Company, had been in commercial operation since August 1954, had passed every normal test and had given no previous evidence of trouble.

At the time of the accident, the unit had been out of service for two days for cleaning of the boiler. It is a regular practice after a turbine outage to re-check the overspeed trip before placing the machine back in service. In this case, it meant separately checking the overspeed trip on both high and low pressure elements of the turbine.

The low pressure element, with a normal speed of 1800 revolutions per minute, had been given its overspeed check and had tripped within the 10% limit. The high pressure element was being brought up for its overspeed check when failure occurred . . .

The explosion occurred before the machine had come up to the trip speed for the high pressure unit. The high and low pressure units were operating in synchronism but were not connected to the bus.

The center section of the spindle shaft, approximately 7 ft in dia and 4 ft long, broke into a number of pieces which were thrown out of the machine along with much of the turbine casing. One section weighing several tons went through the roof of the building and landed in the coal pile to the west of the station building. Another, of comparable size, traveled east and ripped open the tail-pipe on the Unit 1 condenser 300 ft away.

Other pieces cut through the cross-over pipes between the intermediate and low pressure elements of both Unit 2 and Unit 3. One piece also cracked the casing on the low pressure element of Unit 3. Miscellaneous damage was done throughout the turbine room by other flying metal . . .

Unit 1 and Unit 3 were tripped automatically and Unit 2 was tripped by the operator in the control room. The operators remained at their posts and went through their orderly procedure for shutting down the boilers.

At the time the accident occurred, the other three units at Ridgeland were carrying a load of 460,000 kw out of a total system load of 1,850,000 kw. System load was dropping rapidly at the time, and other units were able to respond to the demand without material loss in frequency or other disturbances. The tie-lines to the neighboring systems to the east, which normally carry no load at this time, picked up 190,000 kw . . .

Picking Up Load . . . A most difficult problem was the picking up of the Monday morning daytime and evening loads with 640,000 kw of Ridgeland capacity out of service . . .

Over 600 large customers were called on to reduce their demands by 25%, and the general public was requested to cooperate by reducing load wherever possible. Purchases from other companies over interconnections were made to the extent of approximately 200,000 kw . . .

A remarkable repair job was done within a very short time. A new tail-pipe 12 ft long, 5 ft in dia, and made of ½ in. steel was fabricated and welded into place in order to restore Unit 1 to service. The cross-over pipes on Unit 2 and Unit 3 had both been cut severely, and new sections of pipe had to be welded into place where the damage was done. The casing of Unit 3 had been cracked by flying steel. The crack was sealed by the metal-lock method and a section of steel plate was riveted on . . .

Investigations Underway . . . Investigations are being made to determine the basic cause of the spindle shaft failure. The spindle design is not unusual. The forging itself was subjected to all well-established factory tests including ultrasonic and tests associated with interior boring . . .

TVA Needs Power

Agency claims in annual report more capacity is essential to meet '57 and '58 demands

Tennessee Valley Authority has reported that, for the first time in its history, steam generation under its control exceeded that of hydro. Now, in its just-issued annual report covering fiscal 1954 operations, the agency makes clear that:

- More generating capacity is needed promptly to avoid a power shortage in the Valley area, and
- New capacity must be in the form of steam plants, since "major (hydro) development of the Tennessee River is substantially complete."

The 1954 annual report kicked off the 1955 chapter in TVA's running fight for more money. Throughout the report run dire predictions:

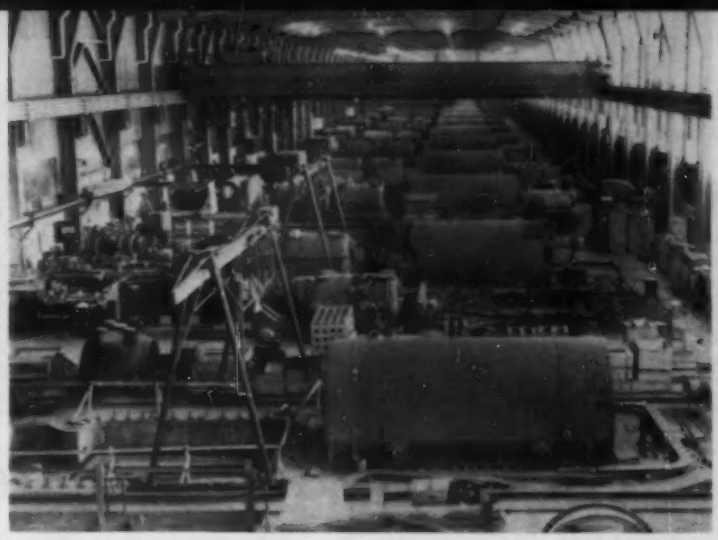
- Generating capacity going into place will provide ". . . narrowest of margins" to meet requirements in 1956.
- Current building program ". . . makes no provision for meeting additional power requirements forecast for 1957 and 1958."

TVA pointed out that it had asked the Budget Bureau last year to approve its appropriations request to finance an additional 1,395,000 kw of generating capacity through construction of a new Fulton, Tenn., steam plant and addition of units at John Sevier, Gallatin and Johnsonville steam plants. TVA was turned down flat on these, and Budget Bureau instead ordered Atomic Energy Commission to negotiate with two private utilities systems—Middle South Utilities, Inc. and Southern Co—for 600,000 kw from a new steam plant not far from where TVA had proposed its Fulton facility.

But TVA's 1956 forecasts would not be altered by construction of the Mississippi Valley Generating Co plant at West Memphis, Ark., because it is not due to be running until 1957.

TVA released these facts in the report:

- By the end of calendar 1956, generating capacity under construction will provide an assured load-carrying ability for the system of 9,443,000 kw.
- Power generation in fiscal 1954 was up 26% from 1953 to 29.9 billion kwhr, of which 17.1 billion kwhr was steam. Steam generation represented a 74% increase over 1953.
- Kilowatthour sales increased overall 26.9% from 1953, but use by federal agencies, mainly AEC, was up 69.4%. "Defense loads" totaled 11.8 billion kwhr and will grow to about 30 billion kwhr in next two years.
- By June 30, 1954, TVA had installed 2.3 million kw of hydro capacity and hydro resources of the region had been expanded to about 3.5 million kw. Counting new steam facilities, total system installed capacity totaled more than 6 million kw, which will grow to about 10 million kw when the program is completed in 1956.
- Net revenue from power operations in fiscal '54 was $28.8 million, a 3¼% return on net average power investment of $890 million.
- Peak system load for the year was 5.3 million kw, on Jan. 13, 1954, more than 1 million over 1953.



CAPACITY AT TVA's Shawnee steam plant passed the 1 million-kw mark when the seventh of ten generating units was placed in operation last month. The Shawnee plant, whose turbine room is shown above, is one of TVA's steam plants which helped steam generation exceed hydro

EJC's General Assembly to Hear 'Nuclear' Talks

Nuclear engineering, employment conditions and unionization, and engineering manpower are the subjects slated to be discussed at the General Assembly scheduled for Jan. 21 at the Hotel Statler in New York by the Engineers Joint Council.

The discussion and open forum on nuclear developments as they affect the engineering profession will have John R. Dunning, dean of engineering for Columbia University, as chairman. Attention will also be directed at the proposed Nuclear Engineering and Science Congress which is scheduled for 1955.

Effect of employment conditions and unionization on the engineer will be analyzed by N. W. Dougherty, dean of engineering, University of Tennessee, when he presents his topic, "Is Collective Bargaining Compatible with Professionalism?"

The address of E. L. Chandler, assistant secretary of American Society of Civil Engineers, will be directed at the "Responsibility of Management and the Employee in the Engineering Profession."

Index Is Available

Electrical World's semi-annual index for July-December 1954 has been prepared, and copies are now available upon request. They may be obtained without charge. Address requests to Electrical World, Editorial Office, 330 W. 42nd St., New York 36, N. Y.

AEC'S POWER CONSUMPTION GROWING AT A FAST PACE

The following tables on power consumption by major Atomic Energy Commission installations were presented by AEC Chairman Lewis Strauss in conjunction with a statement he made at a press conference in Washington last month.

The tables show that the commission's annual power usage this fiscal year (1955) was almost twice that of fiscal 1954. Next fiscal year (1956) consumption will increase by 50% over fiscal 1955 to almost 60 billion kwhr per year.

Tables also show that AEC will get almost half of its total power needs from TVA by fiscal 1956. This block of power represents about 47% of total power generated by TVA.

Power Consumption at Major Atomic Energy Commission Installations

(Data from AEC)

Fiscal year	TVA	BPA	EEInc	OVEC	S.C. E&G	Self Generation	Total	% of total U.S. sales
			(Thousands of Kwhr)					
1944.....	192,195	50,106				21,100	263,401	0.1
1945.....	1,358,870	303,712				499,317	2,161,899	1.1
1946.....	1,564,635	394,236				1,291,346	3,250,217	1.7
1947.....	1,763,922	336,429				1,302,957	3,403,308	1.6
1948.....	1,693,838	321,783				1,294,700	3,310,321	1.4
1949.....	1,716,424	438,887				1,425,700	3,581,011	1.4
1950.....	1,814,800	533,334				1,355,515	3,703,649	1.3
1951.....	2,023,085	627,092	883			1,586,948	4,238,008	1.3
1952.....	4,845,708	700,000	16,340			1,792,889	7,354,937	2.1
1953.....	6,868,815	826,655	723,549			1,696,142	10,115,161	2.6
1954.....	11,560,233	990,922	4,701,552		87,853	2,441,894	19,782,454	4.8
1955.....	23,822,062	1,484,640	7,683,239	3,352,512	323,000	3,118,040	39,783,493	9.0
1956.....	28,668,327	1,983,890	9,608,327	15,471,904	355,000	3,130,040	59,217,488	12.8

Purchased Power Consumed by the Atomic Energy Commission[1]

Fiscal Year 1954
(Data From AEC)

		Consumption Thousands of kwhr	Total Cost	Mills per kwhr	
Oak Ridge[2]					
TVA	Permanent Power	5,328,043	$19,219,003	3.61	
	Interim Power	1,160,830	7,164,069	6.17	
		6,488,873	$26,383,072	4.07	
Paducah					
TVA	Permanent Power	3,842,770	$16,481,652	4.29	Average Cost—5.20
	Interim Power	1,228,590	9,893,150	8.05	
EEInc	Permanent Power	2,912,937	9,376,533	3.22	
	Interim Power	1,788,615	13,808,033	7.72	Average Cost—4.93
		9,772,912	$49,559,368	5.07	
Total Oak Ridge and Paducah		16,261,785	$75,942,440	4.67	
Hanford					
BPA		990,922	$2,439,237	2.46	
Savannah River[3]					
Savannah River Plant (South Carolina E&G)		87,853	$ 553,474	6.30	
Dana (PI of Indiana[4])		324,855	2,535,767	7.81	
		412,708	$3,089,241	7.49	
	Total	17,665,415	$81,470,918	4.61	

[1] Some additional energy is used in other locations but not in substantial quantities and is procured from local sources on regular supply contracts.
[2] Excludes K-25 plant self-generation and use of 1.7 billion kwhr in 1954 at a cost of $7.7 million.
[3] Excludes self-generation and use of 0.7 billion kwhr in 1954 at a cost of $4.7 million.
[4] The Dana plant of 50 Mw is located at Dana, Ind., and serves an AEC installation at that place.

MVGC Foes Prepare Offensive

Exhaustive investigations scheduled of circumstances surrounding contract; Holding Company Act to be aired

The momentary lull in the Dixon-Yates controversy is expected to be broken soon when Democrats who have promised to do something to nullify the power contract begin their offensive.

Early last week, before the Democratic-controlled 84th Congress convened, no loud blasts had been heard from Congressional opponents of the contract. But before long the battle will begin over legislation to repeal the authority of the Atomic Energy Commission to make such contracts, or at least to order AEC to cancel the Dixon-Yates agreement. Exhaustive investigations of the circumstances surrounding the contract, and of the holding companies which sponsored it, can also be anticipated.

Democrats such as Sen Clinton Anderson (N. M.), chairman-to-be of the Joint Congressional Committee on Atomic Energy; Rep Chet Holifield (Calif.), an active Joint Committee member, and Sen James Murray (Mont.), chairman of the Senate Interior Committee, have promised to take action to keep the contract from being implemented.

Holding Company Act Investigation Planned . . . On the investigative front, public power advocates who plan sweeping probes of existing utility holding company systems and administrations of the Holding Company Act of 1935 got the backing last week of a powerful ally—House Speaker Sam Rayburn (D-Tex.), co-author of the Holding Company Act.

Rayburn told McGraw-Hill he was very much concerned with the way the act has been administered, and indicated he would back an investigation by the appropriate House committee. This would probably be the House Interstate Commerce Committee, headed this session by Rep Percy Priest (D-Tenn.), a TVA-area Democrat. Rayburn also expressed the view that Eisenhower's method of directing AEC to negotiate the contract with Dixon-Yates was "high-handed" and that it should be studied thoroughly.

At the Securities and Exchange Commission, where the new Dixon-Yates firm, Mississippi Valley Generating Co, is seeking approval of its equity financing plans, the fight continued, but on a relatively quiet level.

Citizens for TVA, Inc, and American Public Power Association asked SEC to reject MVGC's request for approval of its plans to issue 55,000 shares of controlling common stock to the sponsoring Dixon-Yates companies. This would prevent the new company from going ahead with construction of its proposed new 650,000-kw steam plant at West Memphis, Ark., to fulfill the AEC contract.

Both groups had to file their final statements for the hearing record this week. They have three chances to make their point at SEC—once with the filing of initial briefs on Jan. 11, again when they file rebuttal briefs Jan. 18, and again when they argue orally before the commission. SEC is trying to wrap up the whole affair before Feb. 15, since the AEC-Dixon-Yates contract contains a clause permitting either party to cancel the contract without penalty if financing plans have not been approved by that date.

Citizens for TVA was concerned with "importation" of Dixon-Yates power into the state of Tennessee through the TVA system. A contract between AEC and TVA to arrange for such transmission has not yet been completely agreed upon.

APPA's statement to SEC drew a parallel between the operations of the sponsoring Dixon-Yates companies—Middle South Utilities, Inc, and Southern Co—and the activities of large holding companies investigated in the early '30's.

Those investigations led to the Holding Company Act of 1935, and APPA expressed the opinion that the investment planned by Middle-South and Southern represented the same type of "pyramiding" control with small investment which led to the act. It listed other aspects of the Dixon-Yates contract which it felt paralleled too closely practices condemned by Congress with the passage of that act.

Nema Is Optimistic about '55

During 1954 the electrical manufacturing industry achieved the second best year in its history when its shipments amounted to $15.6 billion. This was only 5% below the 1953 peak volume of $16.4 billion.

This information was included in a report on industry operations issued by the National Electrical Manufacturers Association. The report was prepared by W. J. Donald, managing director, and A. J. Nesti, chief statistician.

'55 Prospects Good . . . In looking ahead to 1955, the Nema officials said the industry expects 1955 electrical equipment shipments to equal or possibly exceed the record 1953 level.

The Nema officials said, "These expectations are based principally upon the increases expected in residential, commercial, and public and institutional construction, and also upon a continued high level of consumer earnings and consumer expenditures."

As was expected, the report noted that most of the branches of the industry fell off in sales volume in 1954 from the high 1953 levels.

These decreases were mentioned in the report: Electric appliances, industrial apparatus, and electrical insulating materials were all off 10%; while electrical building equipment and supplies dropped 8%; and insulated wire and cable dropped 5%.

However, increases were reported for illuminating equipment, 1%; generating, transmission and distribution equipment, 3%; signalling and communication equipment, 10%.

The down-trends of 1954, according to the authors of the report, are expected to be reversed in 1955 for all branches of the industry except generating, transmission and distribution equipment, which is expected to fall off 5%.

With an increase of better than 5% overall expected for 1955, electrical appliances this year are expected to recover much of loss suffered in '54.

Training Program:

To Step Up Employees

Utility Steps It Up

● When the Columbus & Southern Ohio Electric Co was developing a training program, it sought the assistance of a correspondence school with extensive experience in the preparation of technical training material. None of the material available covered the specific requirements for power plant training. It included much that was not particularly applicable in this field.

However, by working closely with the Columbus & Southern Ohio Electric Co's management and training people, the correspondence school developed a course tailored especially for training power plant employees. The training actually consists of two parts:

1. Correspondence school training based on specially prepared text material.

2. Practical training in the plant by company supervisors and training personnel.

The practical phase of the training is emphasized.

Aim Is Upgrading . . . Training is directed particularly at upgrading of employees. Each employee's training is devoted largely to preparation for the next higher job classification.

Most of the power plant employees have a high school education. If not, they are first taught basic high school mathematics and then receive training in formulas. This is followed by the specially prepared material provided by the correspondence school with each employee receiving the training essential to his own upgrading.

A question list has been made up covering the knowledge required for each job classification. Training material covers the answers to all of these questions. When an employee has completed both the text material and the practical training for each classification, he is given an examination which is conducted by the plant training committee.

The examination is divided into three parts: **1.** Description, **2.** Demonstration, and **3.** Operation. Only 20% is written. The preponderance is demonstration, with the employee showing that he knows how to do the job.

There is no secret about the examination questions. The employee can have them when he begins the training for a particular job.

Results Found Satisfactory . . . There have been 65 employees who have completed both the correspondence school and the practical phases of the training. There have been 121 to date who have completed the correspondence school pnase of the training only.

A chronological record is kept of each man's training program. This is all confidential.

This training has assisted in the development of employees for the jobs requiring the higher qualifications. It has been particularly helpful in the training of employees for the operation of new generating units that have gone in service recently.

Plans are now being made for similar development of training for electrical repairmen and other jobs requiring special skills.

ORAL EXAMINATIONS before examining committee form essential part of training program, giving trainees self-confidence

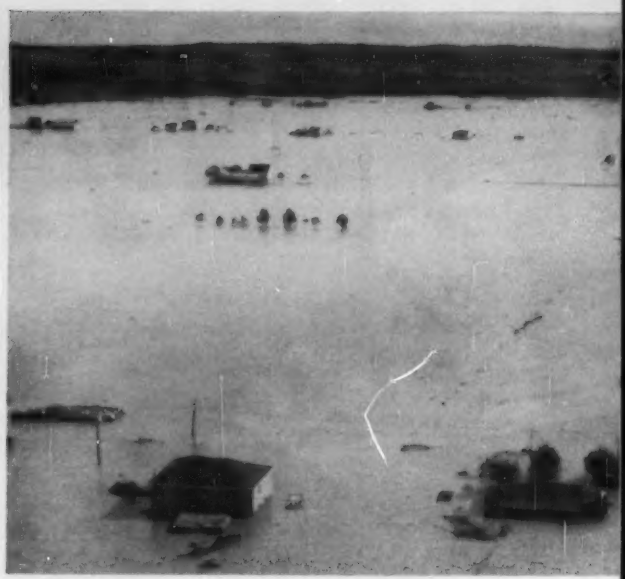
EMPLOYEES get individual attention in their studies from company's training coordinator

E. E. HARTSOCK of C&SOE, goes over proposed program with representative of the correspondence school

EMPLOYEE DEMONSTRATES his proficiency for examining committee. This shows that he knows how to do the job

BURNING THE MIDNIGHT KWHR is required of employee if he is to complete work which will qualify him for job promotion

HELICOPTERS



Careful planning precedes helicopter trip over the area flooded after Hurricane

Helicopters are paying off for the Hydro-Electric Power Commission of Ontario. They have come to be as essential as the line truck. In the rugged, undeveloped areas of Ontario they are cutting expenses, saving time, and proving valuable in operations other than their basic function of transmission line inspection.

Ontario Hydro began its helicopter patrol on June 15, 1949. By Sept. 1, 1954, it had patrolled 312,110 line miles (393,240 circuit miles) and logged 7,699 flying-hours. Today Hydro owns and maintains five helicopters operated by a staff of 16. The staff consists of five pilots, five observers, five air engineers, and one air-engineer-in-training. This group, by Ontario Hydro's estimate, does the work of dozens of men and machines under ordinary methods.

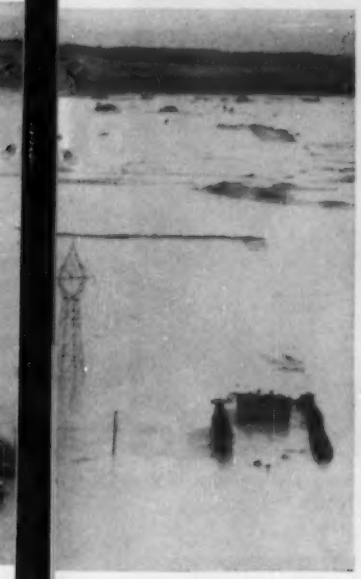
Ontario Hydro networks span the province (which is as large as Connecticut, New Hampshire, Maryland, Maine, Indiana, Kentucky, Virginia, Tennessee, Pennsylvania, Mississippi, New York, and Ohio combined) with 8,100 miles of high-voltage transmission lines. Air inspections have been found to be more thorough than those from the ground, and costs of checking the lines have been cut nearly in half. An important aspect of this work is preventive maintenance or spotting trouble before it develops and thus cutting down on outages.

Savings have been in inspection crew accommodation, vehicles, and the necessary equipment for trips into the bushland as well as in manhours and manpower. Conventional foot, automotive, and occasional boat patrol (now outmoded in Hydro operations) used to consume many manhours. Now one helicopter with a two-man, pilot-observer, crew can inspect about 100 miles of line over the bushland in two-and-a-half hours. A ground crew would require at least five patrolmen and two normal working days to do the same job if all weather and ground factors were in their favor.

Helicopter crews do not, except in extreme emergencies, repair the lines. Therefore, each helicopter is equipped with two-way radio-telephone, operating over a 30-mile radius. At strategic points Ontario Hydro has radio stations to communicate with its radio-equipped vehicles. A report of trouble made to one of these stations is relayed to a mobile repair crew based nearby which then speeds to the trouble spot.

Based mainly at Malton Airport, just outside Toronto, with secondary bases at Fort William and North Bay, the helicopters fan out over 12 provincial patrol areas—from the busy southwestern region to the remote mining area of Red Lake in the northwest. They go north to within 100 miles of James Bay.

Save Money, Manpower, Time At Ontario Hydro



Hazel. In remote Ontario regions helicopters prove valuable

These air patrols fly over some of the most difficult territory in the world, says Hydro, and in great extremes of temperature. Yet it claims a safety record among the best of all helicopter operators. Hydro attributes this to careful personnel selection and rigorous training methods.

The pilots must first have had several thousand hours of fixed-wing flying. Then they are sent for helicopter training to the Bell Aircraft Corp plant at Fort Worth, Texas. Observers are line foremen with at least a dozen years' experience in transmission work. They have to have perfect eyesight and excellent powers of concentration. In addition, Hydro's maintenance standards for its helicopters are severe, going beyond factory specifications and Canadian Aeronautical Association requirements.

Hydro takes further precautions by locating 40 gasoline caches in remote districts. This is for the benefit of bush-flying trips when a machine may be away from its base for two weeks.

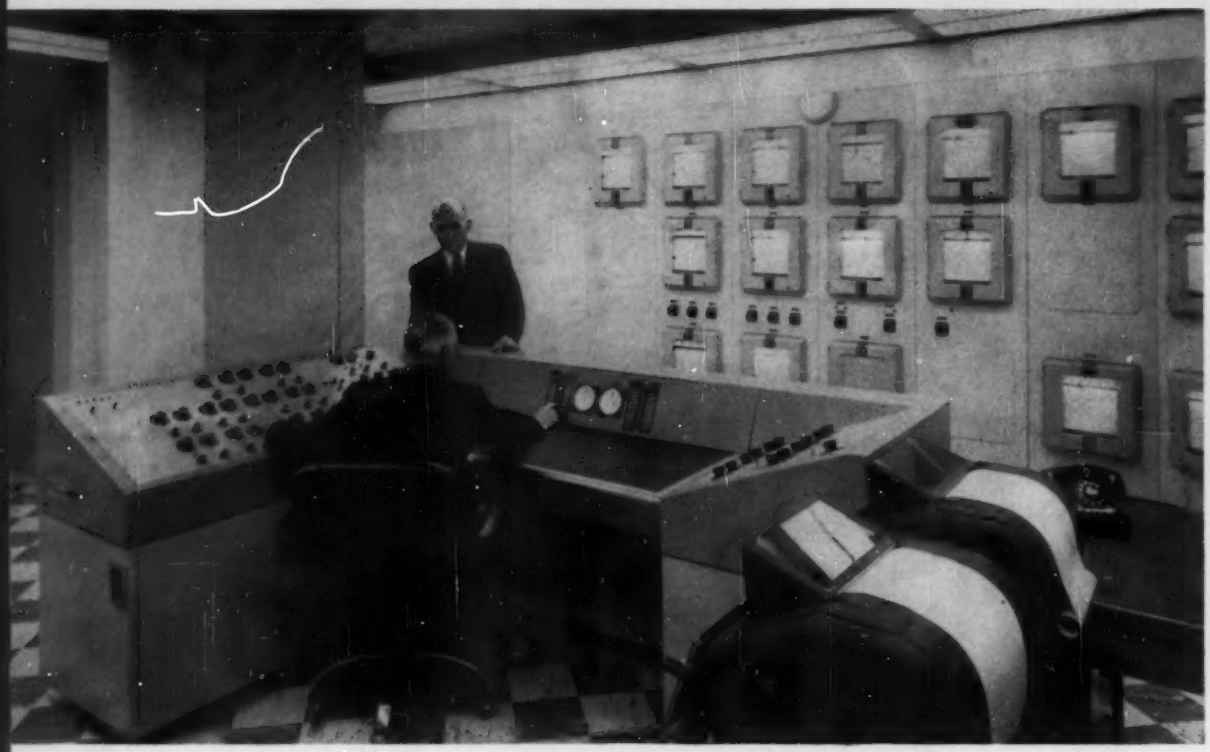
Experience gained in helicopter line patrol work has produced at least one modification in Hydro's standard practice. Formerly tree and brush growth and line patrols were made together, and the reports combined. But it was found that observers had difficulty in doing the two things at once. Now tree and brush patrols are made separately. These reports are then made to Hydro's Forestry Department.

Last year, for the first time, Hydro used its helicopters in spraying rights-of-way in the northwestern region. This experiment of spraying about 240 acres to keep down brush growth was such a success that the service is being expanded.

Helicopters have solved difficult construction problems for Hydro. One was used to hedgehop a transmission line across Puslinch Lake, near Galt, a distance of some 600 yards over broken ice impassable to a ground crew. This technique, which worked perfectly, was used again near Trenton over the turbulent and icy Trent River.

Many utilities have the problem of checking water levels at remotely located dams. It may take a man several days to get to and from a dam on foot. A helicopter gets him there and back again in an hour.

Hydro estimates that helicopters were instrumental in saving over $5 million in construction of the $344-million Sir Adam Beck Station at Niagara Falls. They were used to make hazardous soundings above the Cataracts and these soundings greatly aided the engineers in design and construction of the project. The machines are also proving invaluable to Hydro executives and engineers who want to make rapid inspection of sites for new installations, for aerial photography, and other survey work.



E. D. EARLY, manager of the Southern Co power pool and inventor of the "Early Bird," observes as R. L. Schroeder, power pool supervisor of Southern Services, Inc, sits at the console in the power coordination office. The computer has been in use more than six months

'Early Bird' Guides System Loading

E. DONALD EARLY, Manager of Southern Co Power Pool

GRADY L. SMITH, Power Pool Engineer, Southern Services, Inc.

R. L. SCHROEDER, Power Pool Supervisor, Southern Services, Inc., Birmingham, Ala.

The first incremental cost computer for delivered power, known as the "Early Bird," which takes into account both transmission losses and generating costs, including fuel, today enables the Southern Co to allocate generation among numerous plants and units at the minimal cost of power delivered to load centers. More than six months' operation of the computer, nicknamed for its originator, E. D. Early, Southern Co Power Pool manager, shows the system has been afforded the following benefits:

1. A proper balance of generation is maintained.

2. The power coordinating office knows the point at which a low-cost generating plant becomes a high-cost operation and vice versa.

3. The incremental cost of delivered power of the various power sources is held within an overall range of $\pm \frac{1}{10}$ mill except for generating units operating at maximum or minimum loading limits.

4. Load changes of a generator are made at the rate of only a few thousand kw at a time instead of 20,000 to 30,000 kw.

5. Overloading of transmission lines during load-change periods has been eliminated.

Network analyzer studies had showed potential savings of more than $50 per hr, or some $400,000 a year, through including transmission losses as well as generating costs in determining plant loadings on the Southern Co system. A part of these potential savings was already being realized as the importance of transmission losses was recognized in preparing plant loading schedules. Studies indicated that the "Early Bird," by making possible optimum loading of sources for system conditions actually existing at the time, would effect additional savings of not less than $200,000 a year with no increase in personnel or operating expenses.

During six months of operating experience the "Early Bird" has fully lived up to expectations under extremely abnormal conditions. During the severest drought conditions throughout the Southeast in the past 25 years, primary steam plants have been operated close to maximum output to conserve hydro storages and for the delivery of surplus power to neighboring systems. These conditions have limited the savings realizable through coordinating transmission losses and generating costs. Nevertheless, the

"Early Bird" has demonstrated its ability to hold the incremental cost of delivered power of all sources in their regulating range at the same level and has made it possible to determine losses associated with the delivery of power to other systems.

Power Coordination Office . . . The "Early Bird" has been in operation since last June in the Southern Co's new power coordination office in the Alabama Power Co's general office building in Birmingham. When it was decided to establish this office, Early made a study to determine what improvements could be made in coordinating the Southern Co system power supply of the four operating companies for maximum efficiency. This study led to the development of the "Early Bird."

The Southern Co system is composed of the Alabama Power Co, Georgia Power Co, Gulf Power Co, and Mississippi Power Co, serving an area of about 100,000 sq miles. Generating facilities consist of 15 major steam plants and 18 major hydroelectric plants. At the end of 1954 the nameplate rating of the generating capacity was approximately 3,100,000 kw, of which 900,000 kw was hydro, having a capability of 3¼-million kw.

The generating and transmission systems of the four operating companies are operated as a single system, or power pool, without regard to company or state lines in order to obtain the lowest possible cost of power supply consistent with a high degree of service reliability.

Transmission Losses . . . Transmission losses in the economical loading of generating sources had been previously explored, and equations had been developed for determining incremental transmission losses. These equations and their solution, however, were so complicated that to determine the economical loading of generating plants on the Southern Co system required the solution of about 30 non-linear, simultaneous equations, each with some 30 variables representing the generation of the various units and the power flow over interconnections.

Early realized that potential savings obtainable through considering transmission losses in loading generating plants required a computer for solving the equations instantaneously. Only through such a device could the power coordinator know at all times at which plants and by what amount generation should be increased or decreased for maximum economy of power supply. He undertook the development of such a computer.

While an electronic digital calculator could be designed to solve the equations, Early realized that such equipment would probably be very bulky and extremely expensive. Information on system conditions would have to be assembled and fed to such a calculator by punched cards, magnetic tape, or other means, rendering the process intermittent rather than continuous. Also it would require a special operator.

System Included . . . Early found that by including the actual generating and transmission system as a part of the computing system and using it in effect as the feed-back circuit, his problem was simplified. It was then possible to develop a relatively small, compact computer fully meeting all requirements.

When this idea had been developed along practical lines, Early approached Leeds & Northrup Co with a proposal to design and build such an instrument. The instrument makers, quick to recognize the value of such a computer to public utility systems, were eager to cooperate in its development. Southern Services, Inc., agreed to make a network analyzer study of the Southern Co system to determine the required loss equation constants, and Leeds & Northrup agreed to construct an experimental model and install it in the new power coordination office for field tests.

Difficulties . . . When loss equation constants were derived from the analyzer studies, it was found that the loss equations which had given satisfactory results on other systems were inadequate in representing losses on the extensive and complicated Southern Co system within the required degree of accuracy. The inadequacy of these loss equations was due primarily to the fact that they were based on the assumption that substation loads vary directly with total system load between maximum peak and minimum valley load conditions. Southern Co system substation loads in different areas varied in an entirely different pattern.

Early and Dr R. E. Watson of Leeds & Northrup undertook development of a new loss equation based on the assumption that each substation's load varies between its maximum and minimum as the total system load varies from maximum to minimum. H. R. Koen, R. O. Usry, and Grady L. Smith of Southern Services developed the applicable constants for the new loss equation.

In deriving the loss constants, use was made of a method of determining incremental losses in transferring power from one generating plant to another, based on the difference in voltage phase angles between the two plants. This method had been developed by W. R. Brownlee of Southern Services, Inc.

"Early Bird" Operation . . . When the incremental cost of power from all plants on the Southern Co system is identical, the cost of power supply to the system is at a minimum. To obtain identical incremental delivered cost from each source, the power coordinator selects plants having high incremental cost and decreases their generation. This decreases the delivered cost from those plants.

The power coordinator then selects plants having low incremental costs and increases the generation from them, thus increasing their delivered cost. When incremental costs of high and low cost plants have been boosted or cut to approximately the same level, the proper balance of generation has been met.

Some generators reach their upper or lower generating limits before the condition of identical delivered costs is obtained. Such generators are left at such maximum or minimum loading until system load increases or decreases sufficiently to place them in their operating range again.

Normally, all generators in their operating range have the same incremental cost of power delivered, and this condition is maintained by the power coordinator through proper allocation of increases and decreases in generation among the generators as required to meet changes in total system load.

Schedule Eliminated . . . System incremental cost of power delivered increases or decreases with an increase or decrease in total system load. When

Incremental Cost Computer Determines System Loading

system requirements change, the power coordinator selects a system delivered cost slightly above or below the existing level. Then, by adjusting the dials of the "Early Bird," he determines the exact kilowatt increase or decrease in generation required to equal the new system delivered cost level.

The generating schedule of the past has been eliminated. Instead of operating the system on the basis of estimates prepared by others well in advance, the power coordinator loads the generating sources for maximum economy of power supply under the system conditions actually existing at the time. These may include such important factors as unexpected loss of a generator; power flow over interconnections; unexpected limits on generation resulting from wet coal, leaks in boiler, superheater, or economizer tubes, clogged condensers, etc; unforeseen changes in power supply to non-conforming loads; and the many other unexpected events with which the operator of a large power system is almost continuously confronted.

Hydro Plant Costs . . . Although hydro plants are not normally considered as having an incremental generating cost, the Southern Co has found it desirable to assign such costs so that the "Early Bird" can allocate generation to the hydro plants at times when it will have the greatest value in displacing steam generation, giving consideration to the effect of transmission losses. By assigning the appropriate incremental cost to each storage or pondage plant, the desired daily or weekly generation at such plants is determined, and maximum value of such generation is assured.

For example, maximum hydro generation at the time of system peak may not represent maximum economy since increased transmission losses may more than offset the increased savings in steam generation displaced. The savings realizable through the "Early Bird" can be seen in the following instance.

Two plants have units of similar size and efficiency. Oil fuel at one, however, costs three times the gas fuel at the other. The computer shows that at times both plants operate at the same incremental cost of power delivered, the difference in transmission losses offsetting the difference in fuel costs.

Load Changes . . . Desired load changes are teletyped to the dispatching offices of the operating companies which, in turn, issue orders to the plants for such load changes. When the load change has been completed, it is confirmed to the power coordinator by teletype.

The "Early Bird" was originally designed to load steam units automatically under automatic control for equal incremental cost of power delivered. It was decided to build the original unit without this feature until the computer had been proved satisfactory in actual operation. The Southern Co has now decided to go ahead and place four major steam plants, having a combined capability of 1-million kw, under automatic control.

This program is expected to be completed in 1956.

An added feature available when this addition has been made will be a new meter that will read directly in kilowatts the required change in generation at each generating unit to bring its incremental cost of power delivered in line with that for the system as a whole. This reading is now taken by turning the dial representing output of a particular plant until the cost-of-power-delivered meter gives the correct reading and then reading the corresponding plant output from the dial.

When steam capacity is used for automatic load-frequency control, the "Early Bird" will operate in conjunction with the load-frequency master controller to hold the incremental cost of delivered power for such units at the same level by automatically controlling the load carried by each generator.

Data Required . . . In operation the "Early Bird" requires the following information:

1. Generation of each hydro plant or group of hydro plants in one locality.

2. Generation of system load-frequency regulating plants.

3. Generation of each steam generator or group of two or more identical generators in a station.

4. Power flow over each interconnection with other utility systems.

5. Power supply to large loads that do not conform to the system load pattern.

6. Cost of each type of fuel burned at each plant.

7. Type of fuel currently burned at each plant.

Telemetered Data . . . All continuously changing quantities, such as power flow over interconnections, generation at regulating plants, and power supply to variable non-conforming loads is telemetered. All telemetered information is fed automatically to the "Early Bird." Non-telemetered information as to generator loading, etc, is set in by the hand dials. Provision has been made for cutting out the telemeter feed to the "Early Bird" in the event of telemeter failure, and dials have been provided for hand settings for this purpose.

Computing circuits for incremental generating cost of each generator have adjustable components so that the characteristics of the incremental cost curves may be changed to account for changing conditions. Fuel cost dials calibrated in cents per million Btu have been provided for each type of fuel burned at each plant.

Incremental maintenance and ash handling costs are included as part of fuel cost.

There are switches for changing the type of fuel burned at each plant, such changes often being made on very short notice.

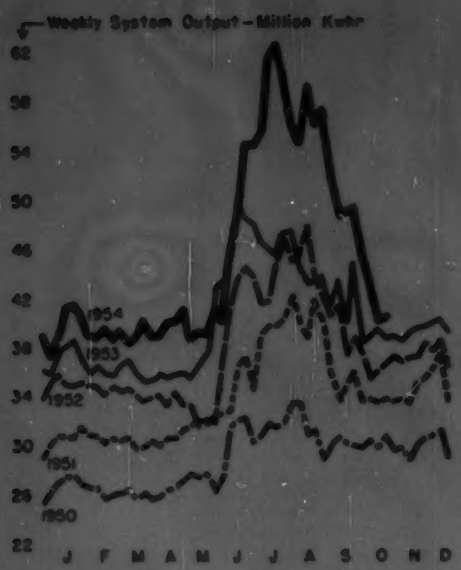
Easy Reading . . . Prior to installation of the "Early Bird," it was not possible to include all the above factors in determining the proper loading of the numerous power sources on the system based on actual system conditions as they change from time to time. The problem was too complex for quick solution even with the most advanced computing equipment.

Now, by merely pushing a button, the power coordinator reads on two meters directly in front of him the percent and cost of power delivered for any source selected. From this information he can determine the amount by which the generation of any generating unit on the system should be increased or decreased to reduce system power supply costs to a minimum.

1954 Heat Storm Forces Utilities to Restudy Distribution Design

EDWARD ALLEN, Midwestern Editor, Electrical World

When the 1954 Heat Storm hit the Midwest . . . These are system conditions that it created and . . . These are emergency measures that power companies took to combat them



SYSTEM KILOWATT-HOUR output curves on practically all systems in the heat storm belt showed big bulge in summer of 1954 as indicated by this one for Oklahoma Gas & Electric Co

When the July, 1954, heat storm hit the plains states from Kansas and Missouri southward to the Gulf, power system loads soared along with the temperatures. Air conditioning sales boomed, and diversity between air conditioning loads was washed out when equipment quit cycling and ran continuously.

Result was the sharpest and most widespread increase in system demands the industry has yet seen. System peak load increases, 1954 over 1953, ranged from 12.8% on the Houston Lighting & Power Co system to 34% on the Arkansas Power & Light Co. system. System growths for other systems were Kansas City Power & Light Co, 18%; Kansas Gas & Electric Co, 27%; Oklahoma Gas & Electric Co, 21%; Public Service Co of Oklahoma, 23%; Dallas Power & Light Co, 17½ %; Southwestern Gas & Electric Co, 21%.

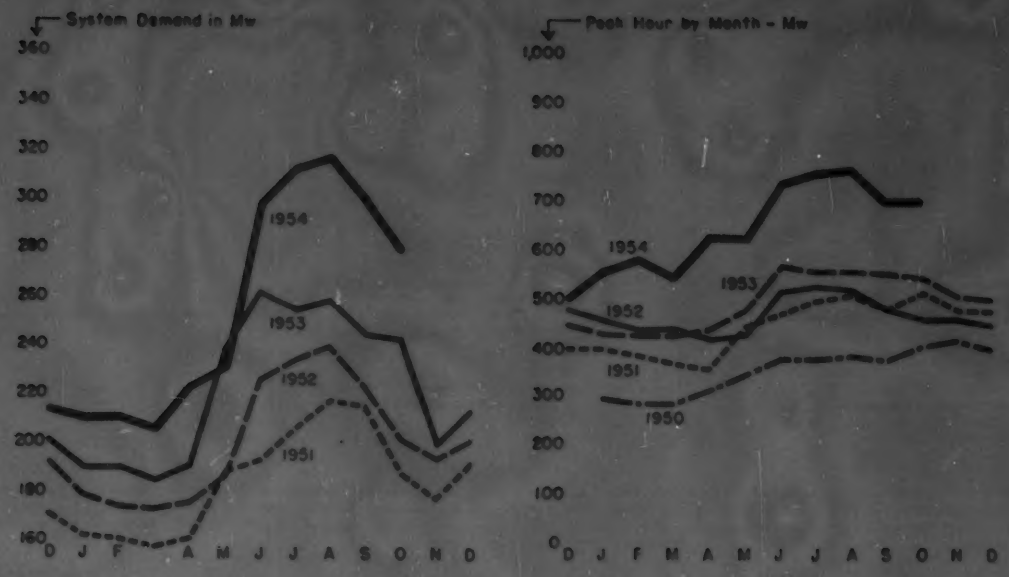
Union Electric Co of Missouri, perhaps one of those hardest hit with air conditioning loads, showed only 3.2% over-all system load increase because of a drop in industrial loads. AP&L's 34% growth was evenly divided between combined air conditioning and water pumping on the one hand and a new aluminum potline on the other hand. Therefore half the increase, that for aluminum production, was not felt on the distribution system. KG&E's 27% system load growth was accentuated by a 38% increase in Wichita.

The result was greatly accelerated programs of distribution system reinforcement. Engineers, line crews, and in some cases sales people worked on schedules ranging up to 12 hours a day, seven days a week.

Change Design Ideas . . . New philosophies of distribution system design developed rapidly. The day of the long secondary bus went by the wayside. When transformers became overloaded, the situation was relieved, more often than not by installing another transformer and splitting the secondary bus.

Already several companies have designed distribution systems for new housing projects with provisions for a transformer on every pole and no secondaries. In general these are 10, 15 and 25-kva transformers. Some distribution men visualize the time when there will be a 50 or a 100-kva transformer on each pole and no secondaries.

Most companies are revising downward their ideas of permissible loads on distribution transformers in recog-



DEMAND ALSO ROSE as the temperature soared. Sales of air conditioners boomed, and those units already in service ceased cycling

PEAK LOAD of Arkansas Power & Light Co, shown on chart above, rose but not so sharply as that of Southwestern Gas & Electric at left

nition of the thermal limitations during the hot weather. Thinking on permissible loads is in the range of 110 to 120% of nameplate.

Distribution substation spacings are being reduced beyond the ultimate visualized two or three years ago. Single-phase primary mains are being shortened to reduce loads on them and balance loads on the circuits.

Small secondary mains, No. 6 and No. 4, are being replaced with No. 2, No. 1/0, or No. 2/0 conductors. The feeling is that there is no advantage in going to secondary conductors larger than these because of the reactance drops.

Special Measures . . . A number of special measures were developed to take care of severe conditions quickly. They included:

1. 240-v capacitors connected in series in the primary neutral leads of transformers to improve voltage conditions.

2. Installation of secondary capacitors either at the transformer or on the end of secondary mains to improve voltage conditions.

3. Paralleling of a number of 240-v secondary capacitors and connecting the group as a series capacitor in a primary main to improve voltage.

4. Installation of booster transformers in customer services.

Some of these were so successful they became standard practice. Public Service Co of Oklahoma has installed 250 secondary capacitors in primary neutral leads of transformers.

New Terms Coined . . . New terms have been coined, such as: "Heat storm" by a Kansas G & E supervisor to describe what hit them; "crash program" by the Union Electric Co organization to describe their activities to meet the conditions that developed; and "cooling factor" by the Union Electric Co engineers, a factor to be added to measured or estimated transformer loads to provide for the air conditioning loads.

What Companies Did . . . How long will this go on? Opinion is divided. But in the areas that have had several years of experience the feeling is that it will go on for a long time. One engineer said that after six years of ever increasing air conditioning sales in the area, he could see no limit to the saturation that might be expected.

If there were a pattern to the problem, it was the overloading of transformers and secondaries and the low voltage caused by overloaded transformers and long secondaries. There were relatively few transformer burnouts, considering loads that developed.

But to get a real picture of what happened, what was done, and what is planned for 1955, it would be well to take a look at each system.

Union Electric Co

Expenditures being made by Union Electric Co of Missouri to reinforce its distribution system are shown in Table I page 68.

There were about 23,000 window air conditioners installed on the system by the end of 1953. This jumped to 54,000 in 1954. The effect of the 1953 sales indicated that some distribution system reinforcement work was needed. In June, 1953, a program of transformer load checks and the replacement of overloaded transformers was started in the St Louis Division. In order that crews could keep up with their other work, the transformer replacement work was done chiefly on Saturdays. All crews worked two Saturdays each month and replaced 200 transformers a month or relieved load on them by installation of another transformer. The total handled in this manner so far is 2,800.

TABLE I—Estimated Cost of Union Electric Co Program for Transformer Replacements and Reinforcement of Primary Mains

1. FIRST YEAR (Sept. 1, 54 to Sept. 1, 55)

	Transformers					
	25 kva	37½ kva	50 kva	75 kva	100 kva	Total
Install	1,600	1,600	1,900	700	30	5,730
Remove	1,000	500	90	0	0	1,590
Net Add'l Transformers	600	1,100	1,710	700	30	4,140
Investment Cost of Net Add'l Transformers	$200,000	$550,000	$1,026,000	$665,000	$31,500	$2,426,500
Cost of installing 4,140 transformers @ $100						414,000
Cost of replacing 1,590 transformers @ $25						39,700
Transformer Installations						$2,880,200
Reinforce 250 primary mains @ $1,700						425,000
Total—First Year						$3,305,200

2. SECOND YEAR (Sept. 1, 55 to Sept. 1, 56)

	Transformers					
	25 kva	37½ kva	50 kva	75 kva	100 kva	Total
Install	1,100	1,100	1,500	500	20	3,920
Remove	700	300	60	0	0	1,060
Net Add'l Transformers	400	800	1,140	500	20	2,860
Investment Cost of Net Add'l Transformers	$153,000	$400,000	$685,000	$418,000	$21,000	$1,677,000
Cost of installing 2,860 transformers @ $100						286,000
Cost of replacing 1,060 transformers @ $25						26,500
Transformer Installations						$1,989,500
Total—Second Year						$1,989,500
GRAND TOTAL						$5,294,700

a. Max-i-Meter load tests on approximately 8,000 transformers at $3.50 per test will cost an estimated $30,000. At a rate of about 50 tests per day or 1,000 per month, this will take eight months from Oct. 1, 1954 to June 1, 1955. This estimate of max-i-meter tests required was arrived at as follows: There are 26,000 transformers in the area 16,000 have been tested since Jan. 1, 1949, and 2,800 have been installed since June 1, 1953. Adding repeat tests and special tests to the remaining 7,200 should bring the total to approximately 8,000 tests.

This work was continued through the winter and accelerated by new loads in the summer of 1954. There are approximately 26,000 distribution transformers on the system. Of these, 16,000 have been reviewed. Of the remainder it is anticipated that 7,000 have not been tested since 1949 and will have to be tested as part of this program. Plans call for completion of work on 60% of these by Sept 1. by selecting critical areas first.

Plan Five-Year Reserve . . . The philosophy behind the program is to provide enough capacity so that it will not be necessary to go back to a transformer in less than five years. A systematic program of analysis and provision for spare capacity has been developed.

On new load checks that are made in the summer, a cooling factor allowance of 0.4 kva per customer is added for blighted areas and 1.0 kva per customer is added for good areas. Transformers are replaced if this amounts to 110% of the nameplate rating. Or, the load is relieved by installing an additional transformer. For load tests made in winter, the cooling factor allowances are 0.6 kva per customer for blighted areas and 1.5 kva per customer for good areas.

On transformers where load tests have not been made within the past five years, the load figures shown by the previous test are used; and 6% per year is added for load growth since the test was made. To this figure the 0.4-kva or 0.6-kva cooling factor per customer is added for blighted areas and 1.0 or 1.5 kva per customer for good areas. If the resulting figure is 110% of nameplate rating, steps are taken to relieve the load.

Primaries and Secondaries . . . It is estimated that there are 250 single phase primary mains that will require some attention. Plans call for the extension of additional phases into these areas to permit better balancing of loads on circuits and improvement of primary voltage.

A complete check will be made to determine which single phase mains should be reinforced. This program calls for completion of this work by July 1.

Long secondaries will be shortened by installing additional transformers.

During the latter part of 1953 and during 1954 the company concentrated on the installation of primary switched capacitors. There were 115,000 kvar of these installed on 4 kv feeders.

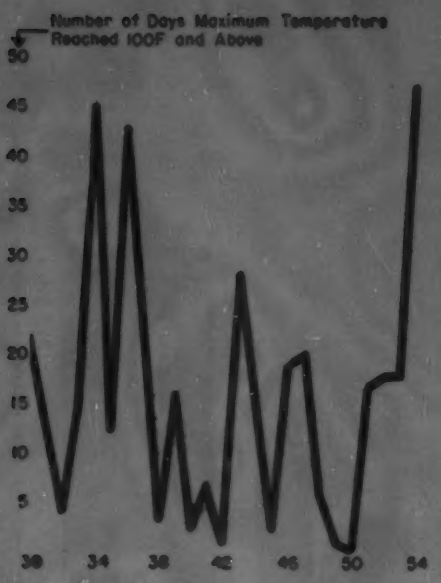
Distribution Substations . . . During the year ended July 1, 1954, there were five distribution substation units added to the system. Four of these were 5,000/6,250-kva units, and the fifth was a 10,000/12,000-kva unit, giving a total self-cooled rating of 30,000 kva.

For the year, July 1, 1954 to July 1, 1955, plans call for the installation of 17 new distribution substation units. Of these, 10 will be 5,000/6,250-kva units, and seven will be 10,000/12,500-kva units, giving a total self-cooled rating of 120,000 kva.

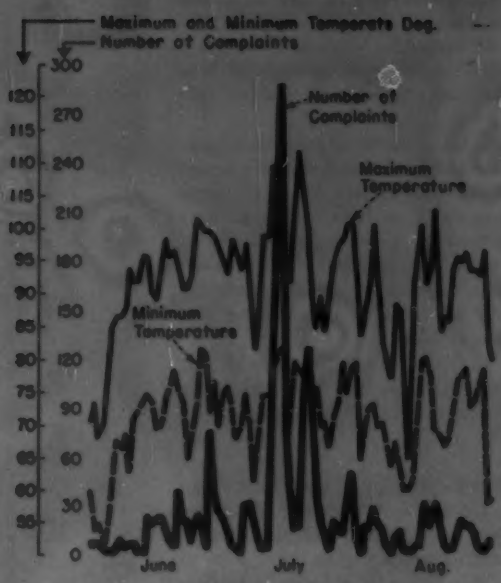
Manpower . . . Union Electric Co of Missouri has used all the measures available for meeting the manpower requirements that developed. The company had been using six contractor crews and 25 of its own crews:

Beginning in July contractor crews were added, and by early November, 14 of these crews were being used. The company added one crew to its own forces in July and plans to add two more crews in February or March.

Crews have been working nine hours a day on five days a week and eight hours on Saturday. It is expected that this overtime schedule will be continued until spring or later.



HOTTEST SUMMER since 1936 was Oklahoma City record. Some cities had record highs including Wichita where 113F was reached



VOLTAGE COMPLAINTS were one of the first indications of trouble. They followed temperatures closely as shown by Union Electric chart

Estimators and engineers have been working 10 hours a day on five days a week and eight hours on Saturday. It is expected that this overtime schedule will be continued until spring.

Four engineers and seven estimators have been added to the organization. Contractors' engineers have been used for designing several large jobs.

Four two-man test crews have been added for making transformer load checks.

Kansas City Power & Light Co

On the Kansas City Power & Light Co system practically every normal operating activity was stopped that could be stopped in order to make men and equipment available to meet the situation.

System and substation loads were showing signs of sharp increases when the number of voltage complaints shot upward. In 1952 there were 852 such reports and in 1953 there were 809. In June 1954 there were 160. In July 1954 there were 1,293 voltage complaints.

To handle this sharp increase in voltage complaints, engineers went out with indicating voltmeters between 4:30 and 8:30 PM. A good check was obtained in most cases without installing recording voltmeters.

The next day the engineers analyzed this data and made sketches showing transformer size, length of secondary bus, and number of customers. From this analysis it was determined whether the trouble was in the feeder, the secondaries, or the transformer. Where transformers or secondaries were involved, the sketch was given to a supervising foreman, short circuiting the routine paper work. The foreman took the necessary steps of replacing the transformer with a larger one or installing an additional transformer and splitting the secondary bus.

Another problem that taxed the capacity of crews was the many changes from two-wire to three-wire service caused largely by 240-v window air conditioners.

Special Measures . . . Other special measures taken to meet the situation were:

1. All feeder voltage regulation was raised 2½ to 5% for the summer heat period only.

2. Rapid primary circuit cutovers were made to provide better load distribution between circuits.

3. "Omitting pins" were removed on time-switched capacitor banks so they would be in service on week ends as well as week days.

4. A special primary series capacitor bank was installed. This bank was made up of 3-kva, 230-v capacitors conected in parallel with the group then connected in series in the primary circuit.

5. The schedule on one distribution substation was accelerated in order to get it in service on July 28 instead of Sept. 1 as planned.

6. Several 300-kva banks of shunt capacitors were installed on the pri-

TABLE II—Kansas City Power & Light Co Transformer Outages Due to Overload

	June	July	Aug.	Sept.	Total
CSP Breakers Open	23	179	34	7	233
Blown Transformer Fuses	1	8	2	0	11
Transformers Burned Up	....	....	....	....	54

mary system early in June on a rush job basis.

7. Secondary capacitors were installed at the extreme ends of long secondaries where there was low voltage.

8. When stocks of large transformers became exhausted, the 10-kva and 15-kva transformers, of which large quantities had been removed, were installed on poles on either side of existing installations to relieve overloads, improve voltage, and make the most of available transformers that were in stock.

9. The 115-v services were altered, where possible, to balance the transformer loading on the low voltage side.

Plans for 1955 . . . Kansas City Power & Light Co had already developed plans calling for cutting portions of the distribution system from 4 kv to 13 kv. This program will be accelerated. Two years of the original cutover schedule is to be completed before the summer.

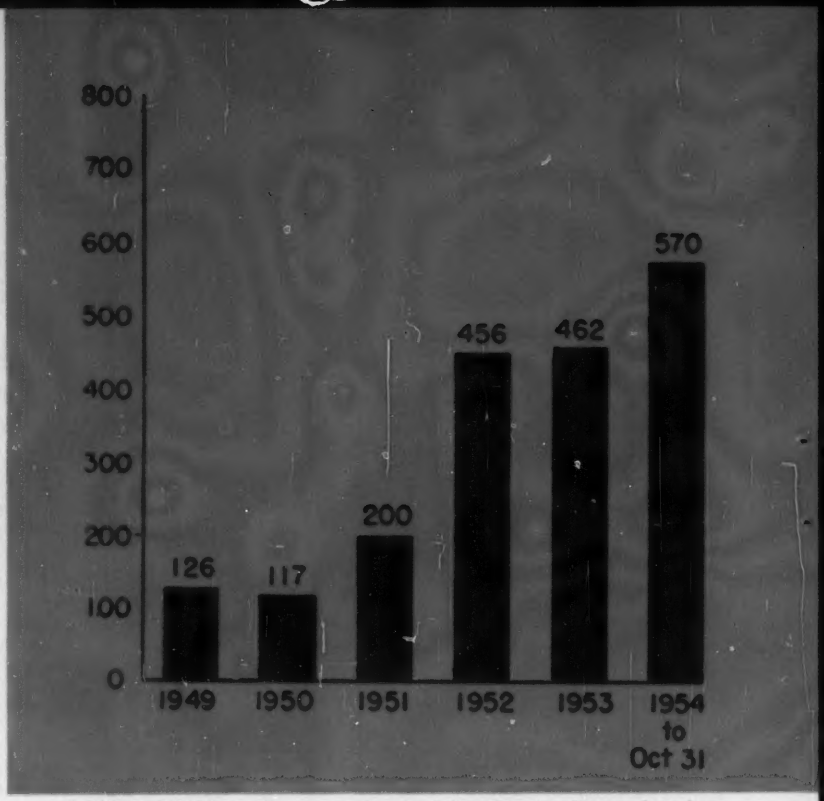
This includes installation of 50,000 kva in distribution substation capacity, 161/13 kv, to handle the areas cut to 13 kv. In addition, some areas will be fed directly from the generator bus. The program also calls for installation of 150,000 kva of 13-kv distribution transformers on the circuits that are cut over. This will be double the present distribution transformer capacity that is installed in the areas.

When loads began to rise sharply the past summer, there were many residential areas with secondaries that extended 600 ft each way. Some of these were changed. Plans for '55 call for going through all of these areas that remain, installing new transformers and splitting secondaries. As an example, in one area that now has 20 transformers, plans call for the installation of 27 transformers to bring the total to 47.

The system now has 10,000 distribution transformers. The proposed program will require installation of 4,000 to 5,000 additional transformers.

In order to complete the work before hot weather arrives, 75 to 100 contractors' crews will be pressed into active service if and providing they are available.

One generating unit, scheduled for 1959, has had its schedule pushed up to 1958.



SHARP INCREASE in transformers out of service indicated trouble. Outages shown here for Union Electric Co were due to blown fuses, breaker trip-outs, and burnouts

Kansas Gas & Electric Co

The 27% load increase on the Kansas Gas & Electric Co system was caused primarily by air conditioning and water pumping. Loads rose sharply when temperatures reached 107 to 110 F, indicating that air conditioning equipment quit cycling and began to operate continuously.

In Wichita the load increase over 1953 was 38%. Sixteen one-mile-square areas had load growths of 100% and some distribution center areas experienced 120% load growth. This was caused partly by new building, but in one built-up area the load growth was 54%.

It was estimated that 95% of the troubles experienced were with secondary distribution and overloaded transformers. In Wichita alone there were approximately 1,000 more distribution transformers installed than normal. Distribution transformer capacity added in Wichita was 30,000 kva.

First indication of trouble was the sharp increase in voltage complaints. Sales department personnel checked these with indicating voltmeters.

While distribution substations did not cause too much trouble, there were some cases where loads were up to 100% above nameplate rating. Lawn soakers were installed on these transformers to reduce temperatures.

In one case a 12/4-kv 160-v substation was built in one day to relieve overloads on existing substations.

There were two locations where regulators were overloaded. They were by-passed during the peak load periods and cut in to buck during off-peak times.

Some line fuses on 12-kv taps were blown. Although they were out only a short time, transformers lost diversity and went out when the line was reenergized.

Fuse sizes on taps were increased. In some cases they were replaced with No. 6 copper temporarily.

Plans for 1955 . . . At summer's end there remained much work to be done. Preparations must be made for a repeat of heavy increase in '55.

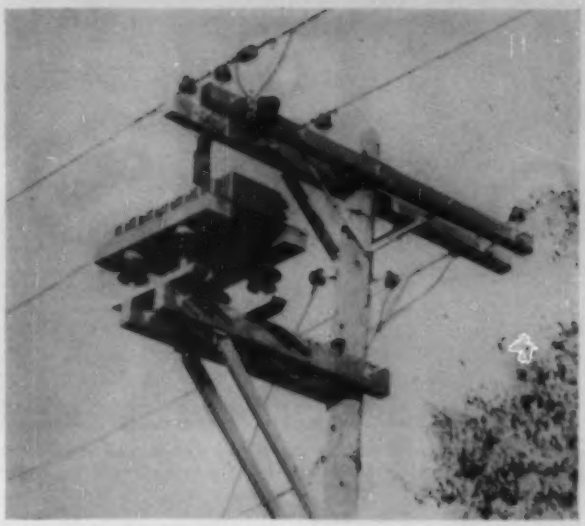
Borderline voltage complaints that were not taken care of earlier have been included in a program of correction, Oct. 1 to Jan. 1.

Representatives called on customers, explained the difficulties, and told them approximately how long it would take to correct that customer's trouble. Customers were very co-operative.

Where the distribution system was in difficulty the investigator made a report on the number of spans of secondary and the size of the transformer. An estimator made up a job. Transformers were replaced or additional transformers were installed as quickly as possible.

Crews worked until midnight, worked six days a week, and several weeks were worked on Sundays. Ten contractor crews were hired for new construction work so that all KG&E crews could be used on the transformer replacement and low voltage complaint work.

To add to the activity, 6,100 two-wire services were changed to three-wire largely because of the installation of 230-v window type air conditioners.



SERIES CAPACITOR INSTALLATION was put together hurriedly to improve feeder voltage. Eight 3-kva, 240-v capacitors were connected in parallel

Primaries and Substations . . . Primary distribution is chiefly at 12 kv. There was no primary voltage trouble on the 12-kv circuits. Some 4-kv circuits were having voltage troubles near the ends.

To correct this a number of primary capacitor banks were installed overnight. Watts, vars, and volts were measured on the feeders at the substations. Current and voltage were measured at the load centers. Primary voltage was measured at the end of the 3-phase primary circuit and on many single-phase taps. If voltage was low, primary capacitors were installed to improve voltage and to relieve overload on substation transformers.

A total of 16,000 kva of primary capacitors were installed in the summer of 1954. Plans call for installation of 20,000 kva in 1955.

During the summer of 1954 there were also 200 capacitors totaling 1,000 kva installed on the ends of long secondary runs.

CPS transformers where red lights were spotted in the summer of 1954 are scheduled for replacement between Jan. 1 and April 1.

Maps are being studied. Where there are long secondaries, additional transformers will be installed; and the secondaries will be split. This work is scheduled between Jan. 1 and the hot weather period.

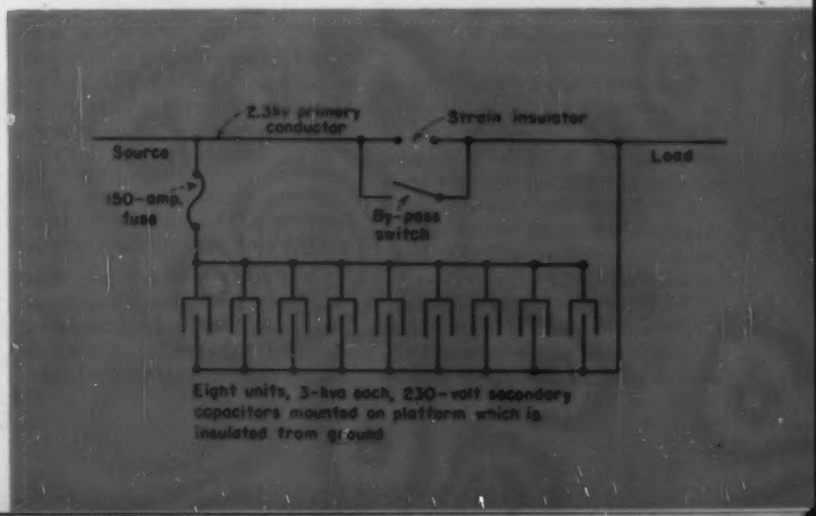
Plans for 1955 also call for continuation of the cutover of 4-kv primaries to the 12-kv system. A load study was made of every square mile in Wichita. Forecasts were made of known load increases, based on building activities in the areas. Loads for the next two years were estimated on the basis of the same percentage load growth that was experienced in Wichita during 1954.

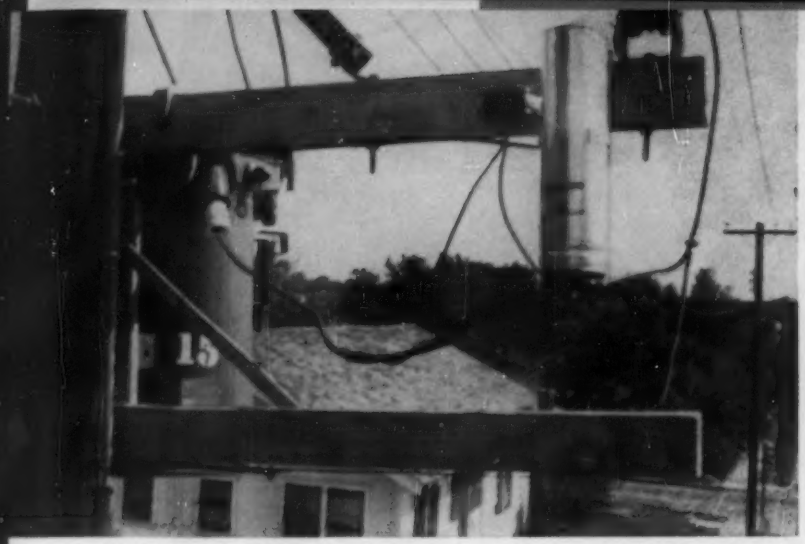
On this information new substation locations were selected, and the circuits to be cut from 4 kv to 12 kv were determined.

When system studies were made several years ago, plans were made for substations at four-mile intervals. In 1952 and 1953, 100,000 kva of distribution transformer capacity was installed in Wichita. Now it has become necessary to install substations between these. Plans for 1955 call for the installation of 50,000 kva of 69/12 kv distribution substation capacity in Wichita. This will be at five locations. It will allow for 30% load growth.

These additions provide for continuation of the cutover of the 4-kv distribution system in Wichita to 12 kv system.

LOW-VOLTAGE CAPACITORS grouped in parallel were connected as a group in series in primary circuit to get quick voltage improvement on Kansas City P&L Co feeder





SERIES CAPACITORS, 240 v, connected in the primary neutral lead of more than 250 transformers solved many of the voltage troubles of the Public Service Co of Oklahoma

Change Ideas . . . Developments this summer have also changed some thinking on distribution system design. Whenever new poles are set now, they will be tall enough to accommodate a transformer.

In one area where new homes are being built, distribution design provides for a 25-kva transformer on every pole. There will be no secondaries. There will be four customers per transformer. Estimated coincident maximum demand is 6 kva per customer. Some individual houses are showing 10 to 15-kw demands.

Oklahoma Gas & Electric

Oklahoma Gas & Electric Co's first indication that things were going to be different was the rise in system load. This was followed by increases in overloaded transformers, voltage complaints, blown transformer fuses, and blown service fuses. Voltage complaints pointed to the real trouble spots.

Two factors saved the situation on this system.

1. The company had been trying since the war to build some spare capacity into the distribution system.

2. The statistical load checks on transformers which were set up several years ago and which are based on kilowatt-hour use.

Despite these factors Oklahoma City crews worked 12 hours a day, six days a week for several weeks and worked some Sundays trying to keep up with overloaded transformers, low voltage conditions, and the large number of changes from two to 3-wire services. They were as much as 200 complaints behind at times and had a backlog of 100 transformer changes to be made. Transformer burn-outs in Oklahoma City, however, were not excessive considering the large number of air conditioners that were installed without notice and the spotty concentrations of the installations. Maximum number of burn-outs was six in one day. Normal for a year is 15 to 20. There were 50 during the summer of 1954.

The engineers too, worked long hours to keep up with their part of the work.

As an example of the rapid turn of events, the transformer at one location was changed from a 10 to a 25 to a 50 kva within a few months.

Predominant transformer size being installed now is 25 kva with some 37½ kva's. Design is for a transformer on every second or third pole. Secondaries being installed now are 1/0 aluminum. There were 32,000 kva of primary capacitors installed. This was according to plan.

Plans for 1955 . . . To avoid future troubles, such as those experienced in 1954, the plan is to:

1. Work the statistical transformer load check, keeping it up to date in all areas and keeping transformer changes right up with the load check.

2. Plan normal line work schedules so that line crews will be available to meet unforseen requirements during June, July, and August.

3. Accelerate the program of converting from 4 to 12-kv distribution.

Other measures that will be taken are:

1. Meter readers will take a count of all room coolers in each home.

2. Changes will be made in the statistical transformer load check to base it on the summer peak load months.

3. Var meters will be installed on transformer secondaries to determine the relationship of kva to kw loading for use in the statistical load check.

4. Transformer loading guide has been revised to provide more capacity for growth, transformer drop, and the low power factor of the loads.

5. Distribution substation capacity will be added to take care of the unexpected load growth this year and the possibility of the same amount of load growth in 1955. Plans call for 16 new distribution substations. New transformers on order for both new and existing distribution substations total 126,000 kva capacity.

6. New substation units have TCUL. Seventeen voltage regulators will be installed at existing substations.

7. Seventeen new feeders are planned as part of the substation additions.

8. Construction of a 161-kv transmission line, 150 miles long, from Bristow to a point 25 miles east of Muskogie, will be speeded up to meet demands for the summer.

Public Service Co of Oklahoma

When the hot weather brought soaring loads, 25% over 1953, to the Public Service Co of Oklahoma system, the majority of the line crews were called on for the replacement and installation of transformers and the splitting of secondaries. The first few hot days, some crews worked all night. Eight contractor crews were hired to help with the work.

When these were not enough, troublemen installed capacitors on the ends of secondaries to improve voltage conditions. On other jobs the troublemen installed 240-v capacitors in the primary neutral leads to trans-

formers on 2,400-v circuits. Both measures resulted in marked improvement in voltage and could be handled more quickly and easily than a transformer change.

Two temporary distribution substations were installed, one in Bartlesville and one in McAlester.

The program of cutting over to higher distribution voltage was accelerated in some areas.

Plans for the year called for installation of 25,000 kva of shunt capacitors. Additional installations totaling 20,000 kva were made in three transmission substations. Capacitors on the system now total 280,000 kva or 0.716 kva per kw of system demand compared to 0.66 kva per kw in 1953.

There were 1,500 service connections processed in Tulsa in one week. Most of these involved the addition of a third wire for air conditioners. The city inspectors could not keep up with the work. Arrangements were made for qualified contractors to sign affidavits that jobs complied with the code. Customers were then given service, and the inspector checked the job later.

The sharp increase in load in 1954 used up planned capacity for two years' growth. It increased forecasts of requirements for the future. In past years plans were based on 9 to 10% load growth per year but this has been raised to 11 to 12% per year.

Plans for 1955 . . . Equipment has been ordered and plans are being made for the addition of three crews to the company's present 16 crews in Tulsa.

Five contract crews started Sept. 1 on a program of changing conductors and upgrading the distribution system. The program also calls for the replacement of transformers, installation of additional transformers, and the splitting of secondaries.

Additional distribution substation capacity will also be provided. Units totaling 45,000 kva in capacity have been purchased for installation in Tulsa.

Dallas Power & Light Co

Heavy summer loads are no novelty to Dallas Power & Light Co. Annual load growth over the past few years has been:

1947—16.2%	1951—21.5%
1948—15.4%	1952—18.6%
1949—25.0%	1953—14.2%
1950— 8.1%	1954—17.5%

So routines have been developed to meet the situation.

The system design provides for banking of secondaries. Not more than three transformers are used on a secondary bus. Most transformers are of the CSP type.

When the hot weather loads come on, the routine for handling the problems is set in operation. A program of checking red signal lights on transformers is maintained.

A man rides over the system and records the locations at which lights have come on. During hot weather the complete cycle of checks over the entire system is completed every eight days.

Red lights found on one day's patrols are turned over to engineers the next morning. Engineers make up jobs for relief of the overload the same day. Relief is provided either by replacement of the transformer or by installation of an added one.

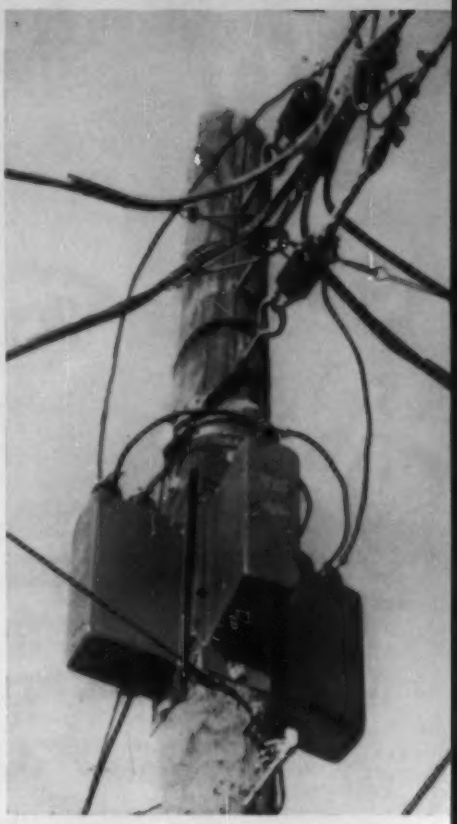
These jobs are turned over to the line crews who do the work the following day. Thus, the work is completed on the second day after the light is found on the patrol.

In spite of this closely followed routine, some transformer breakers open on overload. This is usually followed by the overloading of other transformers on the bus. Their breakers open putting the bus out of service.

For these cases there are 16 trailer-mounted distribution transformers. They are put in service by troublemen to provide service for the night. Work for permanent relief of the overloaded condition is handled by crews the next day.

This is made possible because one or two engineers work during the evening hours through the hot weather and prepare jobs the same evening on all secondary buses that rip out because of overload. These jobs are then ready for the crews the next morning so the work can be done and the transformer trailers can be ready for the next evening's peak load period.

Transformer Loading Schedules . . . In an effort to reduce the amount of trouble during the hot weather, heavy-load period a study of transformer loadings was set up in the fall of 1953. It is based on kilowatt hours used by customers on each transformer. The mechanics of determining transformer loads was set up on the company's modern punch card business machines.



LOW-VOLTAGE CAPACITORS were often connected on the ends of the secondaries

There are approximately 30,000 distribution transformers on the system. The system was studied and an analysis made on the basis of changing transformers that were found to be loaded to:

130% of nameplate rating
120% of nameplate rating
110% of nameplate rating

It was estimated that the net increase in transformer capacity required would be:

10,000 kva based on loading to 130% of rating.
20,000 kva based on loading to 120% of rating.
30,000 kva based on loading to 110% of rating.

Plans for 1954 were based on 130% loading . Actually 11,000 kva

SMALL BOOSTER TRANSFORMERS were connected in services by Arkansas P&L Co

of transformer capacity was added on this schedule before the 1954 summer loads came on.

While this improved conditions appreciably, the loads that developed in 1954 resulted in the installation of an additional 24,000 kva of transformers.

For this reason the study on kilowatt hour loading on transformers will be continued, and the replacement schedule will be based on 120% of nameplate rating. It is estimated that under this program another 20,000 kva of transformer capacity will be installed before the summer of 1955.

Dallas has also made some changes in distribution design standards. Two years ago standard secondary size was No. 4 copper. In 1952 that was changed to No. 2/0 aluminum. On banked secondary buses in areas of high load density, transformers are spaced three spans apart so that each transformer normally feeds one span each way.

Houston Lighting & Power Co

While Houston Lighting & Power Co's system load in 1954 was only 13% above the 1953 load, air conditioning and other residential loads continue to rise rapidly. This adds to distribution system requirements and frequently has the effect of overloading facilities.

An estimated 4,000 transformers were replaced or installed because of new residential air conditioning loads in the summer of 1954. The usual transformer installation has been increased 15 to 25 kva. The average length of secondary has decreased from 600 ft to 300 ft. Secondary wire size has changed from No. 6 and No. 4 copper to No. 1/0 all-aluminum. It is necessary to take 3-phase primary into all subdivisions to keep the load balanced. The low power factor of this load makes it necessary to install both primary and secondary capacitors.

The first indication of trouble is usually a voltage complaint or a blown transformer fuse. On a voltage complaint an emergency crew gets the report by radio and goes to investigate. They talk to the customer and check the voltage, transformer size, and transformer load with a tong-test ammeter. They raise or lower voltage as required by changing taps on the transformer. More permanent correction may be made later if necessary.

Secondary capacitors are installed near the transformers where the transformers are one-half mile or more from the substation.

Distribution substation capacity is being continually increased. In 1953, 9 units totaling 67,500 kva were installed. In 1954 there were 14 new units with a total capacity of 116,250 kva. These are OA ratings. Plans for 1955 call for the installation of 200,000 kva of new distribution substation capacity.

The cutover from 4 to 12 kv distribution is continuing. Some of the new 12-kv feeders that are being planned for 1955 will use 600 MCM all-aluminum conductors.

Southwestern Gas & Electric Co

Air conditioning loads have been building up on the Southwestern Gas & Electric Co system over the past several years. But, like other systems, it was usually hard hit in 1954. System load growth was 21% over 1953.

To meet the demands in 1954 the anticipated $2.2 million expenditures for minor distribution extensions ran to about $3 million. Contractor crews were used for this work. Normally 50 crews are used the year 'round, and 15 crews are added for the heavy work load in June, July, and August. At the end of the summer period last year the force was only reduced by four crews because the crews were still catching up on the work that the summer's loads indicated should be done.

Much of the increased expenditure was for distribution transformers. This item exceeded budget figures by 38% or $¼ million. This provided 17,000 kva of transformers more than were anticipated.

Chief difficulty experienced has been with low voltage and distribution transformer overloads. In old built-up areas where secondaries were No. 6 copper and 600 ft long, one air conditioning unit would cause trouble. It was then necessary to install additional transformers and split the secondaries.

Service changes from two-wire to three-wire also added a lot to the work load. In the extreme weather there were 25 to 35 of these changes per day. Dealers have now realized that they must sell the 240-v units.

While Shreveport has had several years of experience with growing air conditioning loads, there was about 50% more activity in 1954 than in 1953.

Crews are still working on marginal voltage conditions.

The distribution system expansion program had to be accelerated. Distribution is being cut from 4 to 12 kv as the load requires.

Plans for 1955 . . . The unusual load growth this year has resulted in increasing the 1955 budget by 23% over the budget for 1954. Projects originally planned for 1956 have been moved up to the 1955 schedule. The schedule on one 100,000-kw generating unit has been moved up.

The distribution budget has been increased 39% over original budget plans. The transmission budget has been increased by 12%.

Four new 66 12-kv substations have been scheduled for 1955, and the capacity of several others will be increased. Total increase in substation capacity will be 80,000 kva.

Plans for 1955 primary capacitor installations have been increased by 38,000 kva, bringing the total scheduled to 55,000 kva. There will also be some secondary capacitors included in the program.

The 1955 plans call for the installation of $875,000 of distribution transformers, to add capacity and shorten secondaries.

There will be more conversions from 4 to 12 kv distribution.

Plans are being based on another hot summer and load growth to match that experienced this year. The budget is being prepared well ahead of the usual schedule so that work can be started early.

Arkansas Power Light Co

Although Arkansas Power & Light Co's system peak increased 34% in 1954 over 1953, half of this was through the addition of an aluminum pot line. The effect of the air conditioning shows up best in residential kilowatt hour sales over the past 10 years. The summer months showed only a slight rise up until 1950. Beginning in 1952 sales took a sharp upturn with the summer temperatures. This effect was accented in 1954.

However the distribution system was able to handle loads without too much distress. This was due chiefly to a continued program of build-up of the distribution systems throughout the service area in the past several years.

The rebuild program included cutting to 12-kv primary and provision of space capacity in primaries, transformers, and secondaries. This included installation of more transformers and shortening of secondaries.

Distribution substation capacities were increased too, as shown in Table III.

Meanwhile, a 115-kv loop was being built around Little Rock. It was closed in 1954 and now provides two-way feed to load centers around the city.

With all of these, system voltage was well stabilized. There was no noticeable increase in voltage complaints. Troubles that developed were handled in routine manner.

Voltage testers worked late, to midnight on many nights. Engineers did not work overtime, but some engineers were shifted from other duties to the handling of the summer's load problems. Construction crews were also shifted from other work. They did not work overtime. Service crews did work overtime as required, chiefly in changing two to three-wire services. There were from 25 to 60 of these a day in Little Rock alone during the hot weather.

Measures for correcting overload and low voltage conditions usually involved installing an additional transformer and splitting the secondaries. But voltage complaints were handled in many instances by servicemen. They checked voltage and made corrections by:

1. Changing transformer taps.
2. Installing a booster transformer in the service to provide a boost of 5 to 10%.

Capacitors have also been used extensively. Secondary capacitors are installed at every new transformer installation and where transformers are installed on rebuild jobs. They are installed at the ends of the secondaries.

Primary capacitors are also used extensively. Plans for 1955 call for the installation of 25,000 kva of primary capacitors. Most of these will be in 300-kva banks. There will be one 2,700-kva package installation at a substation.

TABLE III—Increases In Distribution Substation Capacities

Arkansas Power & Light Co

Year	
1949	65,333
1950	58,382
1951	47,200
1952	65,305
1953	72,490
1954	143,750

Load Building

While load building plans have not crystallized, all of the companies contacted felt that efforts must be concentrated on the building of wintertime loads. This points toward electric space heating.

However, other load building tools are not being overlooked. Mentioned in plans of one or more companies were: lighting, electric blankets; clothes dryers; electric ranges; water heaters; commercial cooking, and commercial flood lighting.

Kansas Gas & Electric Co sees the air conditioning activity as an aid to load building. The trend is toward the larger window air conditioner units that will operate at 240 v. This summer 6,100 services were changes from two to three-wire to accommodate these units.

Each of these customers is considered a good range prospect. Dealers who sell these air conditioners are giving the information to their salesmen as leads for range sales. KG&E is providing an incentive bonus of $3 per range sold by all dealer salesmen. Range sales are up 27% over those of 1953.

KG&E has also developed a list of questions on electric heating and has made the questions and answers available to customers. Employees are meeting with builders and electrical contractors to provide them with the facts about electric heating. A demonstration trailer, for use in rural areas, has been equipped with a heat pump.

KG&E has also published a booklet on the available types of electric heating equipment.

Consideration is being given to the promotion of the heat pump with supplementary resistance heating for handling low temperature swings. Special attention is being given to the promotion of heat pump air conditioners.

KG&E has developed an elaborate long-range lighting program. It has added four home lighting advisors and reassigned one girl to specialize in home lighting.

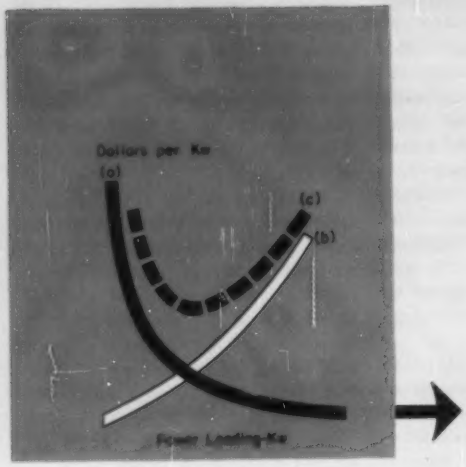
Commercial cooking and outdoor commercial lighting for advertising purposes are also parts of the KG&E load building program. Salesmen have been given special training in the sale of flood lighting.

Murray Gill, chairman of the board of KG&E, has emphasized the importance to all employees of improving the company's load factor. Every employee is being enlisted in the company's sales activities.

Load factors of companies in the more southern climates have not been bothered too much by the air conditioning load. Daily load factors of this load are extremely high. Much of the equipment operates practically 24 hours a day. Where the season lasts four to six months the result is a reasonably good load factor. However, all companies with summer peaks are looking toward electric heating and other appliances for the development of winter loads.

Public Service Co of Oklahoma is promoting the heat pump type of window air conditioner and subsidized wiring for these units up to $35.

There have been 1,600 of these units installed on the system to date. The air conditioners are chiefly one-ton units.



Problems Mount in Transmission System Expansion

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Many utilities today face serious problems in bulk power distance transmission arising from circumstances forcing them to locate power plants 50 miles or farther from load centers. Not only are new plants more distant from the communities they serve, but the paucity of desirable sites available is compelling the industry to put more capacity into the fewer plants.

Moreover, for many years population and industry has been moving away from dense metropolitan areas. Realty values have risen and property restrictions have been imposed in suburban districts where there were only farm lands a few years ago. Consequently, utilities are finding it increasingly difficult to obtain rights-of-way for overhead bulk power transmission lines between plant sites and load centers. As a result, the economics of transmission-line loading are becoming a more important aspect of system planning.

The economics of transmission-line loading may be divided for convenience into two types of costs: Those that are not directly a function of the power to be transmitted and those that are. The first group includes:

1. Right-of-way.
2. Transmission line.
3. Circuit breakers and steel structures.
4. Direct and indirect associated overhead. The costs which are directly a function of the power to be transmitted include:
5. Transformer costs.
6. Power loss costs.
7. Reactive generation costs.

Economic Loading . . . When cost items 1 through 4 are divided by kw to be transmitted, the most economic loading, as it appears in curve (a), Fig 1, would be an infinite value. When costs increase with power loadings, items 5, 6, and 7 are divided by the kw, loading, and the most economic loading (curve (b), Fig 1) would be zero. Combining curves (a) and (b) results in curve (c) which gives the true picture, as there is definitely an optimum loading associated with it.

Fig. 2

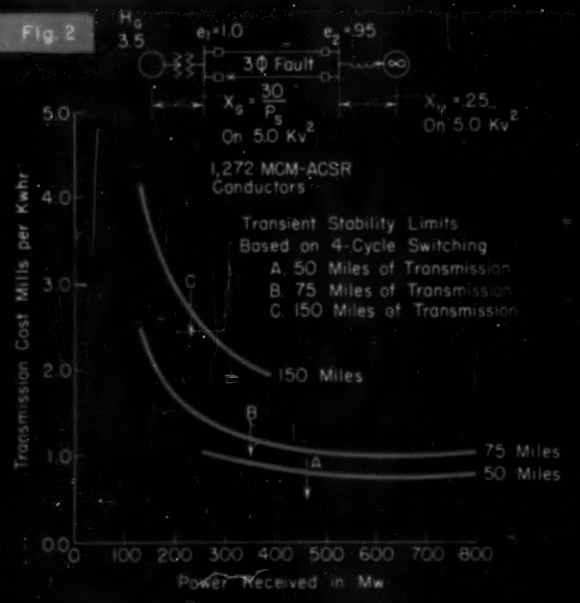
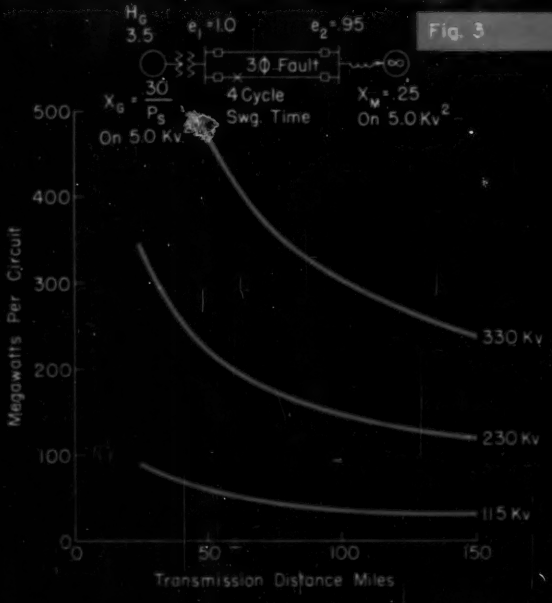


Fig. 3



Unfortunately, long transmission lines cannot always be firmly loaded to their exact optimum points dictated by costs alone. Peak load to be carried is not controllable in a precise manner. The line loading is affected by its relative electrical impedance with respect to other parallel paths of flow as well as by actual plant output and how the circuit is terminated. The power loadings on transmission lines extending from power stations can be made to approach the most economical levels only by restricting the number of circuits from the power station. In so doing, the circuits must not be restricted to so small a number that transient instability would result following a severe line fault. Such heavy circuit loadings could not be considered as firm delivery even though costs would indicate that optimum loadings have been achieved.

Transmission costs of a 230-kv system in mill per kwhr are plotted as a function of total power received in Mw. Points A, B, and C, respectively, indicate transient stability loading limits for 50, 75, and 100 miles of transmission. Assumptions pertaining to system disturbance and breaker clearing time are also shown.

In Fig 2 as the transmission distance increases, the transient stability power limit diminishes, thus precluding operation near the optimum loading. Examination of many cases of bulk power transmission from large generating stations, and also at different voltage levels, reveals that transient stability often determines the most economic maximum firm loading for parallel circuit lines of distances longer than 50 miles. For shorter distances power limits are usually high enough to permit operation at optimum values determined from costs alone. Cost data in these comparisons are from "Transient Stability Limits and Their Effects on the Choice of Conductor Size," by R. M. Butler and D. L. Hopkins, 1954, AIEE Transactions, 54-220.

Economics Relations . . . If it is assumed that transient stability power loading limits correspond to the most practical economic circuit loading for transmission distances of 50 miles and greater, it becomes possible to approximate conservatively what circuit loadings may be carried for various voltage levels and transmission distances. Approximate maximum Mw loadings per circuit are shown in Fig 3 as a function of transmission ditsances for voltage levels of 115, 230, and 330 kv. These loadings are conservative and in many instances could be somewhat higher from a stability viewpoint, especially for distances shorter than 50 miles.

The approximate number of circuit rights-of-way for transmitting power from a large generating station into a load area at various voltage levels can be determined from data in Fig 3 pertaining to maximum circuit loadings. Fig 4 shows the approximate number of circuits for various amounts of power and different voltage levels for a transmission distance of 50 miles. Fig 4 also shows how right-of-way problems multiply when 500 Mw are generated and transported 50 miles at 115 kv compared with voltage levels of 230 or 330 kv. Plant capacities of about 900 Mw can be handled with only two 330-kv circuits.

In the future the number of rights-ofway may conceivably be the principal problem, and the voltage level may be selected with a view to minimizing it. New generating stations in the order of 500 to 1,000 Mw, remote from distribution areas, may then be common. The relative economies of using various voltage levels above 100 kv for 50-mile bulk transmission are compared in Fig 5. This figure shows that plant capacities of about 250 to 500 Mw would require 230 kv and plant capacities above 500 Mw 330 kv for optimum economy. These generalizations must be tempered by conditions met in practice.

Conductor Sizes . . . Large conductors on new transmission lines are an important means of cutting costs and future right-of-way requirements. The required current capacities per circuit from large generating stations at relatively short distances from distribution areas may be a critical factor well below stability loading limits. Conductors considerably larger than 4/0 copper equivalent size at 115 kv and lower are not only economic but helpful in reducing the total number of new rights-of-way required

Fig. 4

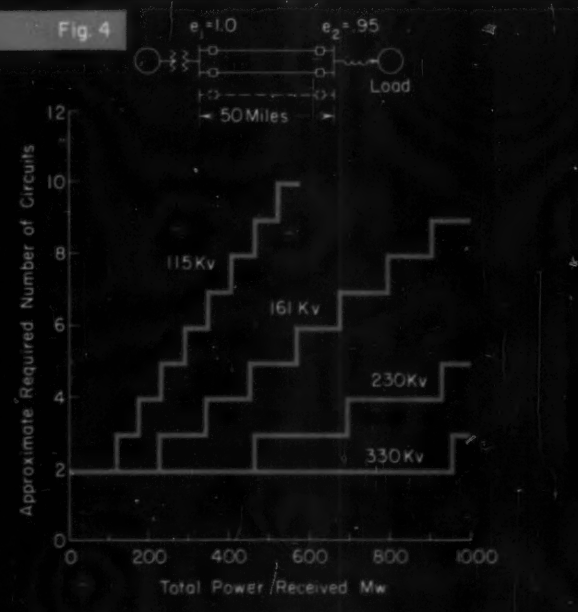
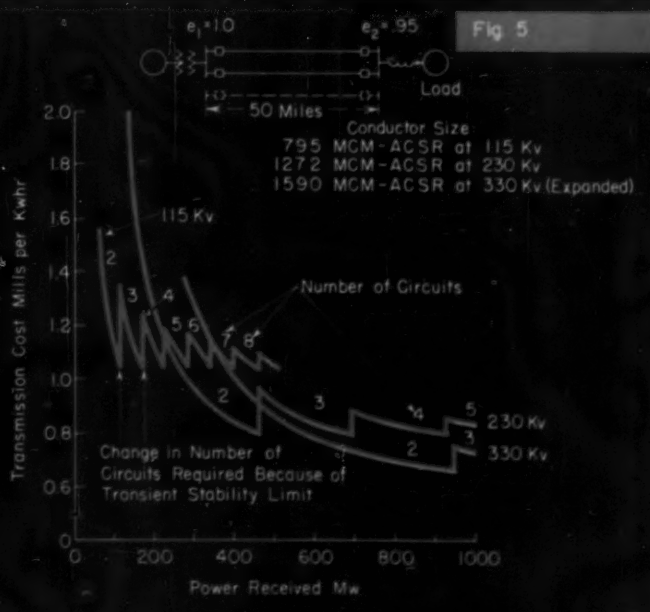


Fig. 5



when the ultimate plant capacity is reached. Fig 5 gives cost of transmission in mills per kwhr versus power received in Mw per circuit, a transmission voltage level of 115 kv and a transmission distance of 25 miles being assumed.

Each 4/0 copper conductored circuit has a thermal limitation on loads above 50 Mw if one of two circuits is to carry the entire load following a line outage. But circuit loadings up to the stability limit can be carried, and at lower cost, when the conductor is 795 or 1,272-MCM ACSR.

Large conductor sizes also help to reduce the receiving end reactive generation requirements during emergency operation following loss of a heavily loaded transmission line

Many operating companies are engaged today in reconductoring existing transmission lines originally built with small conductors, a practice which appears to be a valuable means of increasing the loading capabilities of existing circuits. Such reconductoring, however, must be carried out in advance of heavy line loads approaching the conductor's thermal limits. If the delay is too long, the circuits may be so heavily loaded they cannot be spared for reconductoring operations.

Fortunately, the salvage value of old copper is usually quite high and can help defray part of the reconductoring expense, and often the old conductor can be re-used on new distribution circuits. Fig 7 shows where reconductoring two existing 69-kv circuits can be more economical than building a third circuit using the existing copper size. For this comparison, the following cost assumptions are made:

1. New 3/0 copper, 69-kv line = $14,000 per mile (including new right-of-way)
2. Net salvage value of 3/0 copper conductors including removal = 28¢ per lb
3. Reconductoring existing 69-kv circuits with 397.5-MCM ACSR = 40¢ per lb
4. Annual charges on investment = 15%
5. Power losses:

   Demand charge = $150
   Energy charge = 3.5 mills per kwhr
   Loss factor = 23%

The existing 30-Mva load is assumed to be increasing 6% per year. Fig 7 shows the annual cost for power loss and line construction over a ten-year period. Accordingly, it would have been economical to reconductor between the third and fourth year. The thermal limit reached at the sixth year reflects a condition wherein the total load equals the maximum ampere capacity of one line when the second line is opened for maintenance.

Duo-Conductors . . . Despite limited experience in this country, a few utilities have considered using two conductors per phase or duo-conductors as an alternative to reconductoring the line with larger copper. Duo-conductors have the added advantage of reducing reactance per phase and hence reducing line voltage regulation. They also eliminate the necessity of removing the existing conductor, providing the conductor can be prestressed.

Line voltage regulation is compared in Fig 8 among a single 477-MCM-ACSR conductor per phase on a 50-mile, 115-kv transmission line; a single 954-MCM-ACSR conductor per phase; and, duo-conductors per phase using 477-MCM-ACSR spaced 12 in. apart. The curves indicate that duo-conductors considerably reduce line regulation. Additional experience is needed concerning the mechanical problems associated with duo-conductors, but it appears that bundling of conductors, holds promise of being a good means of increasing existing line loading capability.

Kvar Supply . . . When bulk power transmission systems are heavily loaded, voltage difficulties appear unless an ample supply of load-area reactive generation is available. Power loss considerations also call for load-area reactive generation. Large generating stations, electrically remote from load distribution areas, do not supply reactive generation in proportion to their capabilities unless a large voltage gradient is permitted between the sending

Fig. 6.

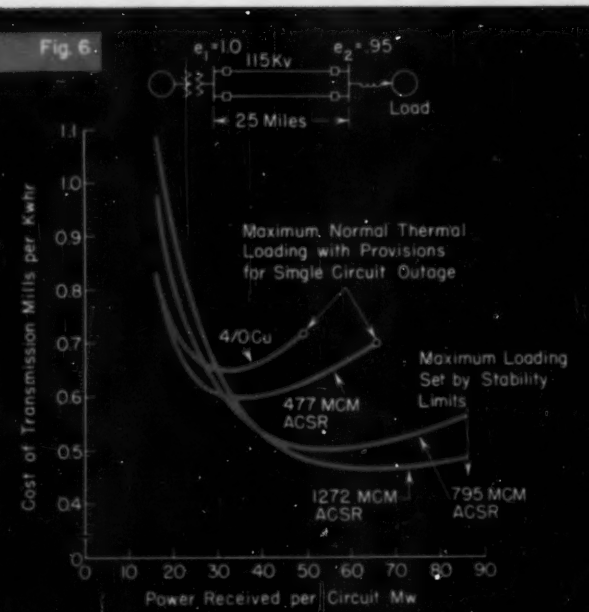
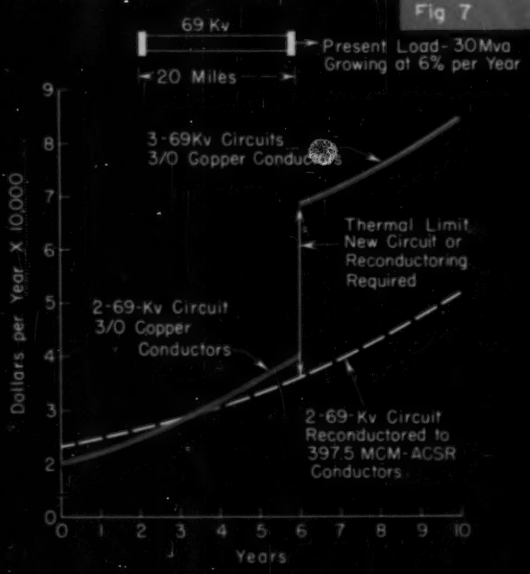


Fig 7


69 Kv
20 Miles
Present Load - 30 Mva Growing at 6% per Year
3-69Kv Circuits 3/0 Copper Conductors
Thermal Limit New Circuit or Reconductoring Required
2-69-Kv Circuit 3/0 Copper Conductors
2-69-Kv Circuit Reconductored to 397.5 MCM-ACSR Conductors
Dollars per Year X 10,000
Years

	CASE A	CASE B	CASE C	CASE D
1. Permits heavy circuit loadings without large voltage and power flow changes during line outages.	Excellent	Fair	Poor	Good
2. Permits logical addition of generation and substations at low incremental cost.	Excellent	Fair	Poor	Good
3. Conveniently permits the addition of sectionalizing stations at any point.	Excellent	Poor	Poor	Excellent
4. Permits simple and reliable protective relaying on all parts of high tension system.	Excellent	Good	Good	Fair*
5. Relatively low initial cost.	Highest	Intermediate	Lowest	Intermediate

* Reliable Protection May Require Additional Breakers Depending On Particular Case.

end and transmission load buses. But this method of operation is not economical from a power-loss standpoint nor satisfactory from a voltage viewpoint during emergency operation following an outage of a heavily loaded transmission line.

Fig 9 illustrates the importance of load-area reactive supply on transmission losses and load voltage, power loss is plotted in per unit on a surge impedance loading base (2.5 kv²), as a function of net load reactive in per unit on the same base for a single transmission circuit operating at the surge impedance loading. Solid curves represent transmission distances ranging from 25 to 150 miles.

Minimum losses occur when net load reactive kva is zero or in the leading region. But more important is the effect on receiving terminal voltage indicated by the dashed curves. A reactive load of 0.484 lag or 0.90-pf lag on a 50-mile line results in a receiving voltage of approximately 92.5% of the sending voltage, or about a 7.5% voltage drop. On a 100-mile line the same load would result in a very low voltage, less than 85% of sending voltage, with corresponding high kilowatt-hour losses.

The importance of load-area reactive correction is also shown in Fig 10 for a line of moderate length (50 miles) where the load power is varied from a relatively low value of 0.5 to a high value of 2.0 per unit of surge impedance load. These considerations place a challenge on distribution engineers to maintain distribution substation power factors close to unity so as to avoid transmission voltage and loss difficulties, particularly when remote power stations are developed.

An additional factor that should be recognized is that a heavily loaded transmission line needs considerable load-area reactive kva support during system emergency operation when an important line is opened. In such circumstances poor power factor conditions can lead to severe voltage drops. Fig 11 shows the relation between power transmitted on a pair of 50-mile circuits and load reactive kva when the change in load voltage is limited to a certain desired percentage after a single-circuit outage.

A 10% change in receiving voltage would often be quite severe even though permitting no change in voltage would

Fig 8

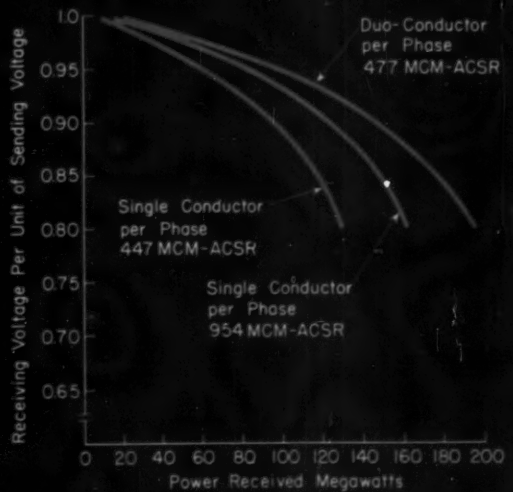
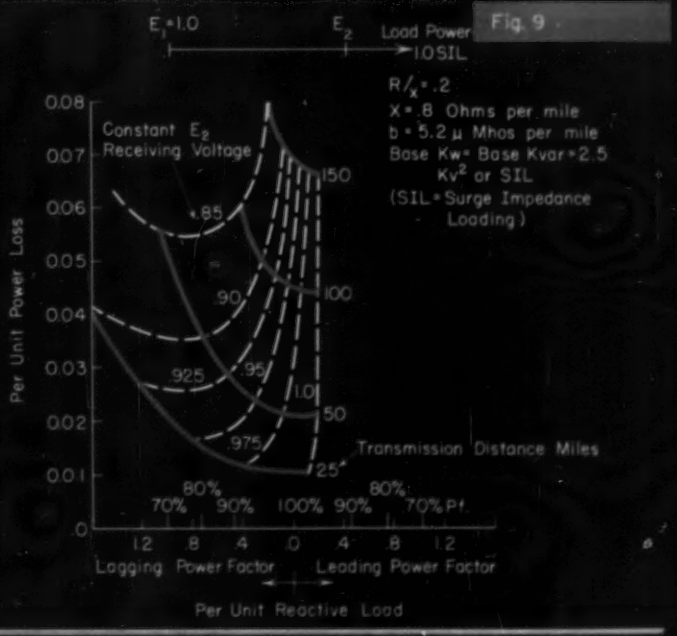


Fig. 9



be expensive. Assuming that a 5% reduction is permissible, a normal peak load of 1.5 per unit per circuit would require the net reactive load to be corrected to 0.25 per unit leading kva per circuit (Fig. 11). Load area reactive generation requirements should be planned to include emergency conditions as well as for normal operation, particularly with systems developing or planning to develop large and remote generating stations.

Transmission System Patterns . . . Literature on the relative economics of transmission system patterns is somewhat limited, although it is a subject becoming increasingly important because of the trend to larger generating stations, heavier circuit loadings, and high capacity interconnections between companies.

General studies indicate that in developing new power plants, regardless of size, the outgoing transmission circuits should be arranged in patterns which avoid long loops. Of course, terrain and the availability of rights-of-way often have a determining effect on the pattern. Nevertheless it is wise to study the influence a given pattern will have on future expansion beyond the immediate problem. Such studies often indicate that somewhat

(*Continued on page* 163)

Fig. 10

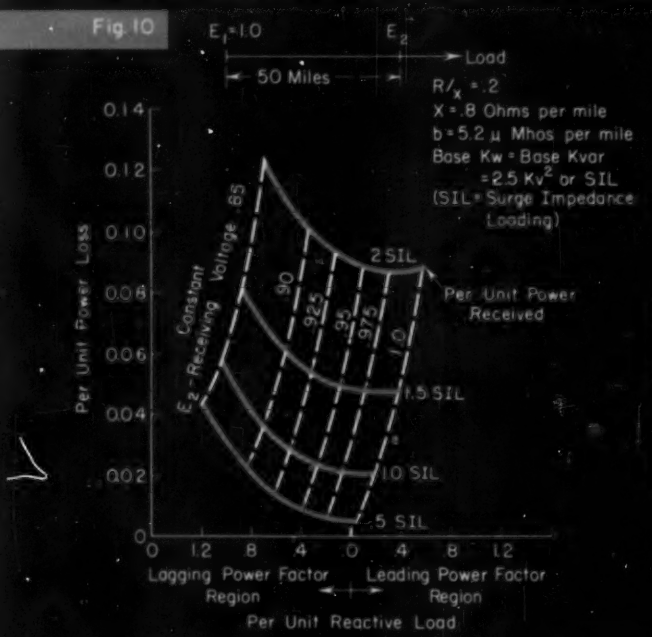


Fig. 11

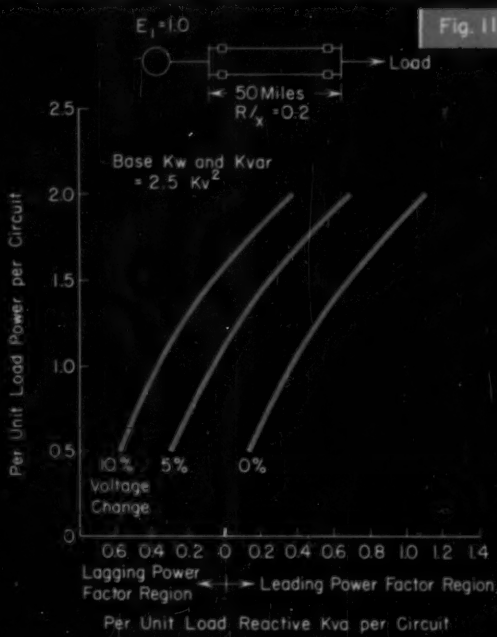


Fig. 12

Several Common Transmission Patterns

PROJECT SERVICES REPORT

ARBUCKLE STATION, first outdoor station on the O G & E system, is furnished completely with General Electric equipment. Third largest on the system, this station adds 70,000 kw to meet growing load in southern Oklahoma.

New all G-E Arbuckle station boosts capacity of Oklahoma Gas and Electric system over 20%

Sharply increased residential and commercial loads throughout southern Oklahoma created the demand for the newest station of Oklahoma Gas & Electric Company. The third largest station in the O G & E system, this new installation alone adds over 20% to system capacity.

Arbuckle Station is an outstanding example of a modern outdoor plant whose single-boiler turbine-generator supplies 70,000 kw to the system. All electrical equipment, including the turbine-generator for the station, was furnished by General Electric Company with a project team assigned to co-ordinate equipment design, manufacture, and installation with the electric utility and its consultants, Sargent and Lundy.

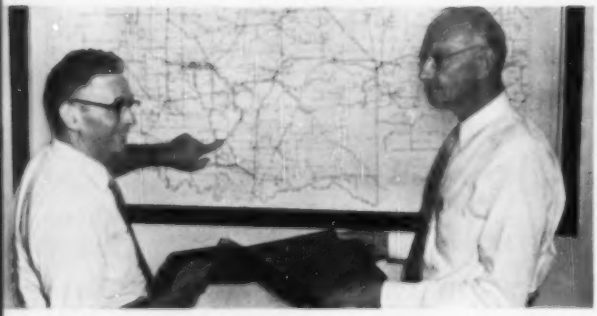
GENERAL ELECTRIC

For further details, see next page ▶

PROJECT SERVICES REPORT

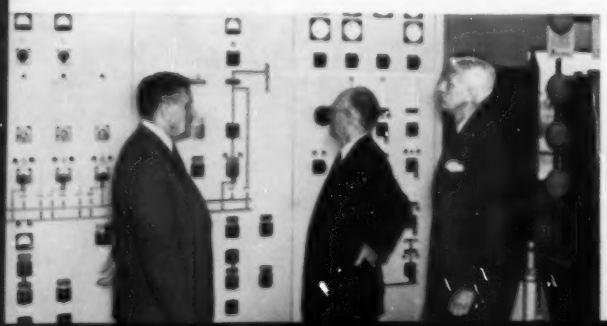
70,000 KW TURBINE-GENERATOR is largest on O G & E system. Governing mechanism, exciter are encased in weatherproof housings for reliable outdoor operation. Turbine is tandem compound double-flow, with steam conditions of 850 psig, 900 F. Design of station auxiliaries, such as Metal-Clad switchgear and station transformer, permits outdoor placement.

Oklahoma G&E, Sargent & Lundy select G-E

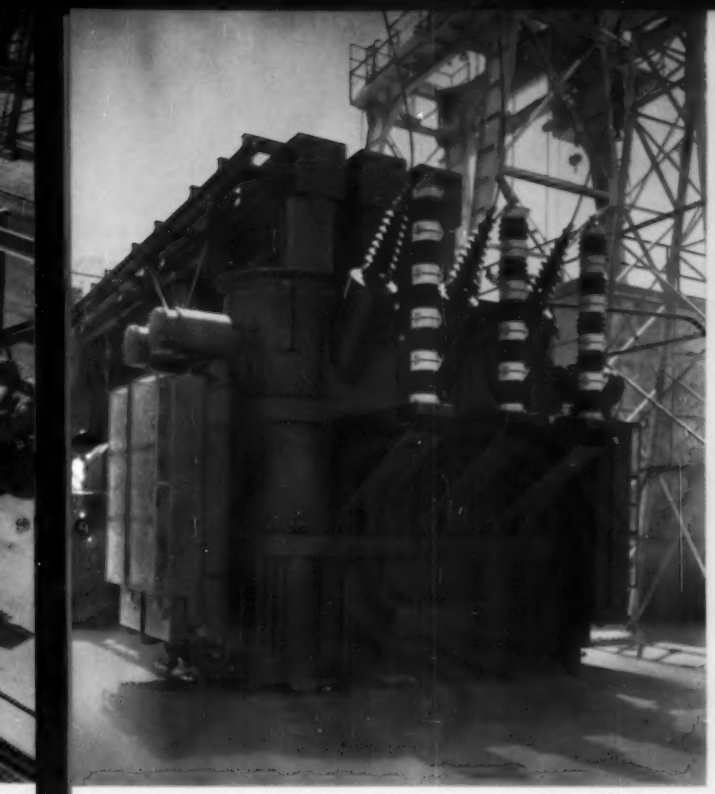


EARLY PLANNING of Arbuckle Station found J. W. Blake (left), Superintendent of Generation for O G & E, discussing plant location and basic one-line electrical diagram with G.E.'s Ralph Randall of Oklahoma City. Such preparation permits early allocation of manufacturing space and faster shipment.

OUTDOOR SWITCHGEAR is of weatherproof Metal-Clad construction. This equipment, located immediately below the G-E isolated phase bus and station auxiliary transformer connections, provides the ultimate in protection with its revolutionary Self-X flame retardent insulation.

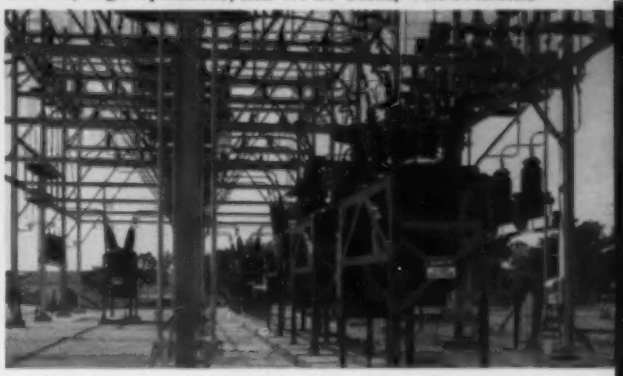


"ON-THE-LINE" DATE brought (left to right) L. Skog, President of Sargent and Lundy; W. B. Gesell, Vice-President—Operations for O G & E; and C. H. Linder, Vice-President—Engineering of G.E., to the G-E master control board which coordinates efficient operation of this 100% G-E equipped station.



MAIN POWER TRANSFORMER, rated 82,500 kva, 69 kv, is forced-oil-air cooled. Shipping all assembled except bushings and accessories brought savings in cost, installation time.

REGULAR G-E PROJECT REPORT is studied here by O G & E's R. F. Danner (left), Mgr.-Engrg. and Construction; Otis Howard, Mgr.-Operations; and W. B. Gesell, Vice-President.



HIGH-VOLTAGE SWITCHYARD uses 69 kv oil circuit breakers. Design, manufacture, and delivery of all switchyard equipment, including steel structure and electrical cable, is handled as a unit.

equipment, benefit from unit responsibility

Oklahoma Gas & Electric's new 70,000 kw Arbuckle Station demonstrates the important economies of unified equipment selection and installation. Sales and engineering specialists of General Electric, working as a project team, assisted the utility and its consultant in fully integrating equipment design, manufacture, and delivery, helping keep the installation on schedule. Such teamwork not only makes it possible to meet the required service date but also saves money in installation.

General Electric's vast facilities for producing electrical equipment for the Arbuckle Station were marshalled by the project team. The local sales engineer, product specialists, and utility application engineers assisted with proper selection, design, and electrical co-ordination. Scheduling co-ordinators issued regular consolidated equipment status reports. On the site, field and installation engineers followed through to assure correct installation and operation.

Project Services teamwork on installations involving major electrical components can help electric utilities and their consultants save time and money and conserve engineering manhours. For example:

SIMPLIFY ORDERING OF EQUIPMENT, purchased either directly, or through your consulting engineers, or through a machinery manufacturer.

CONSERVE ENGINEERING TIME by handling electrical details which frees you and your consulting engineers for other urgent problems.

INTEGRATE EQUIPMENT DESIGN to assure the maximum flexibility and effectiveness of plant operation.

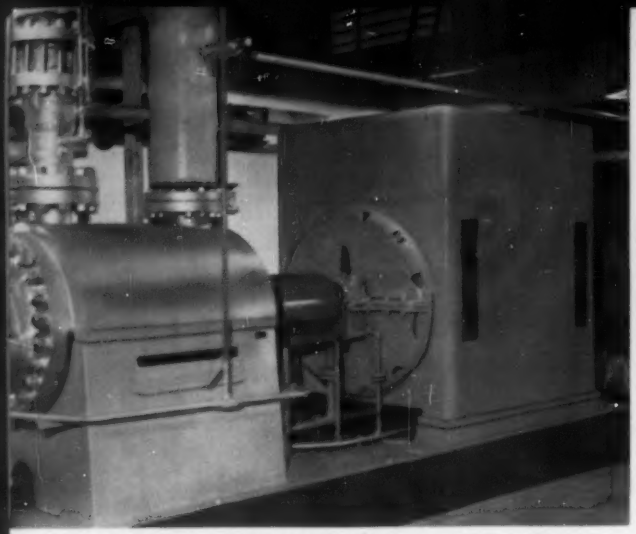
SPEED CONSTRUCTION by scheduling the arrival of equipment for maximum installation efficiency.

ASSIST IN INSTALLATION AND IN TRAINING OPERATORS to assure minimum start-up time and better understanding of the full operating capabilities of the equipment.

For details contact your General Electric Apparatus Sales Office, or write Section 302-2, General Electric Co., Schenectady 5, N. Y.

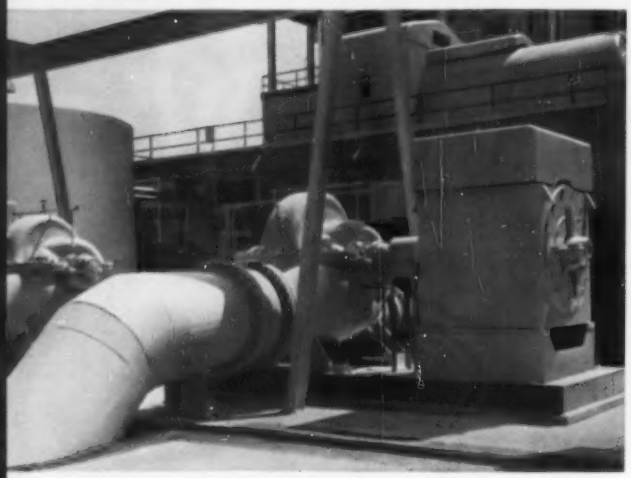
GENERAL ELECTRIC

See next page for more data on project services ▶



BOILER FEED PUMP MOTORS, rated 1750 hp, have overhead vent (far side of motor above) to keep exhaust from personnel and adjacent motor intakes.

RELIABLE POWER SUPPLY for eight cooling tower fan motors, outdoor load-center unit substation is double-ended, equipped with advanced-design drawout switchgear.



WEATHER PROTECTED MOTORS supply 700 hp each to circulating water pumps. This construction permits outdoor installation without further protection.

TOTALLY ENCLOSED CONSTRUCTION protects cooling tower fan motors from spray, dirt. Details, such as control in main plant, are followed by G.E. team.

Auxiliary motors and controls, from boiler feed pumps to cooling tower fans, supplied by G.E. for first all-outdoor station of Oklahoma G & E

All electric motors and controls for the new Arbuckle Station were specifically engineered by General Electric for power station application. Through the project team's efforts, selection, ordering, and installation of these motors were all greatly simplified.

Field-proven motors, available in all sizes and types from G.E. for every operating need, meet power plant requirements, in several designs and enclosures.

For details on Project Service, contact your G-E Apparatus Sales Office, or write for GEA-6302 to Apparatus Sales Division, General Electric Co., Schenectady 5, N. Y. 302-2

More Power to America

GENERAL ELECTRIC

Test Table Calibrates Street-Light Relays Four at a Time

LAURL SANTA ANA, El Paso Electric Co, Texas

Increased use of series street lighting prompted El Paso Electric Co to design a test table for quick and accurate calibration of four photoelectric control relays at one time. The table also provides the means to quickly check control units for short circuits or defective insulation.

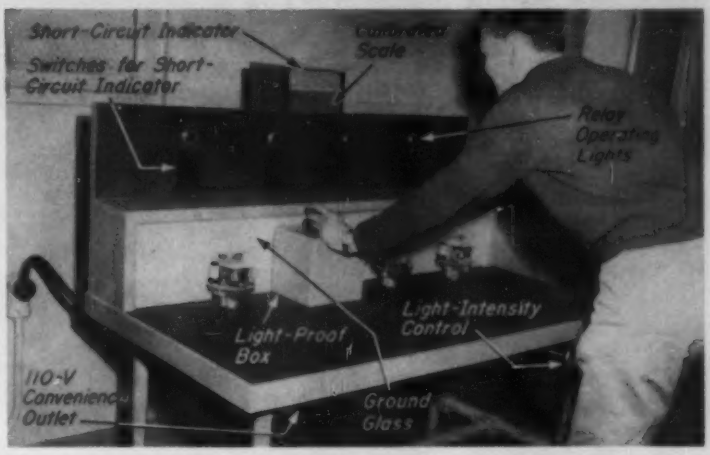
Test table consists of a variable light source, calibration standard, lights to indicate short circuits or relay operation, and various switches. Light source is a 4-ft daylight-type fluorescent lamp mounted behind a frosted glass pane. Four sockets for control relays are positioned in front of the glass.

Voltage of fluorescent lamp circuit is 240 v to permit better control of light intensity, especially at the lower levels. Starting button for the lamp is located under the right front edge of the table. Light intensity is controlled through an induction regulator in series with the lamp. Regulator is operated by a hand wheel at the front of the table.

To provide accurate calibration of control relays, a modified watt-hour meter is inserted in the 240-v circuit. The meter frame is located in the center of the table above the fluorescent lamp and behind a ground glass pane that has a scale calibrated in lumens. Attached to the meter disk are a retarding spring and pointer. A 110-v lamp positioned directly in front of the meter disk shaft throws a shadow of the pointer on the calibrated scale.

Located directly above the meter behind the ground glass, but in a separate compartment, is a 110-v lamp which indicates short circuits in the control relays. Lamp provides sufficient ballast to prevent short circuits from blowing fuses in the 110-v circuit. Lamp is put in series with any or all control relays through spot switches mounted on the table front. Above these switches are 110-v lamps which indicate when relays are operating.

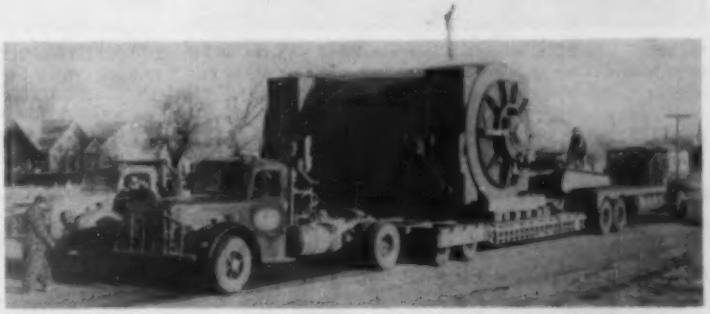
Before relays are calibrated, the operator places spot switches in the "up" position. Relays are inserted in the sockets one at a time to check for short circuits. If short-circuit indicating lamp glows, the relay is set aside for repairs. With four unshorted relays in place, the operator moves the switches to the "down" position and calibrates the relays.



TEST TABLE uses a fluorescent lamp behind the ground glass as a light source. Intensity is varied through an induction regulator. Modified watthour meter is the calibration standard

Fluorescent lamp is turned on and the light intensity is adjusted to a level above that desired for relay operation. After relays are sufficiently warmed up, light intensity is gradually decreased until the desired intensity is reached. Control relays are adjusted so that each turns on at this level. To eliminate effects of random room lighting, each relay is covered with a light-proof box during calibration.

Box is a 6 in. cube but with the bottom and one side left off. A small hole in the top allows the operator to adjust the calibrating screw on the



100-Mw Unit Moved on Two Trailers

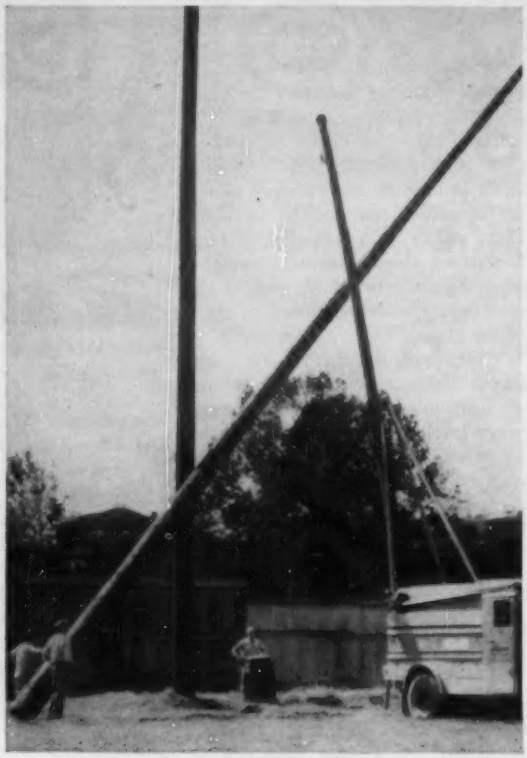
Four tractors and two trailers were teamed up to move a 100-Mw generator 12 miles from rail siding to the site at Plant X for Southwestern Public Service Co. The entire move was made without incident in about 6½ hr.

The 373,600-lb generator load was distributed over 64 wheels on the trailers and tractors. One of the lowboy trailers was a 100-ton unit owned by the company; the other a 75-ton unit provided by the trucking contractor. Two rear tractors helped support the weight of the generator as well as push or pull as demanded by the route. Support was provided by a winch line over the tail piece on the rear of the tractor to the rear of the trailer.

relay with a screwdriver. To speed up the testing routine, it is expected that three additional boxes will be made. After all units have been calibrated, the light intensity is increased gradually to check the level at which relays will turn off.

Test table is 54 in. long and 30 in. wide, with a 19-in. high back. Working area is 30¾ in. off the floor and is 22 in. deep to provide sufficient room for light-proof boxes and necessary parts. Horizontal table areas, ends of fluorescent lamp space, housing for meter frame and short-circuit indicating lamp, and light-proof boxes are of wall board. Backing of table is 1 x 4-in. lumber. For making repairs with a soldering iron, a 110-v convenience outlet is located under the left front edge of the table.

SECURING GIN POLE in position is accomplished with two rachet chain binders at top of A-frame and one binder at base of the pole



LIFTING LONG POLES is simplified by securing a pole to the A-frame on truck. Winch line for A-frame is used with special gin

Mobile Gin Saves Time Raising Long Poles

C. M. FLETCHER, Line Supervisor, Appalachian Electric Power Co, Bluefield, W. Va.

A mobile gin pole comprising a long pole fastened to an A-frame saves time when erecting or removing two or more poles that are taller than can be handled with the A-frame. Moreover, the mobile gin eliminates installing and removing conventional gin poles and associated guys.

Where terrain and overhead clearances permit, the mobile gin pole can be used advantageously to position steel during construction of substations. Limited loads can be picked up and placed at points much higher than can be reached with an A-frame, by moving the truck.

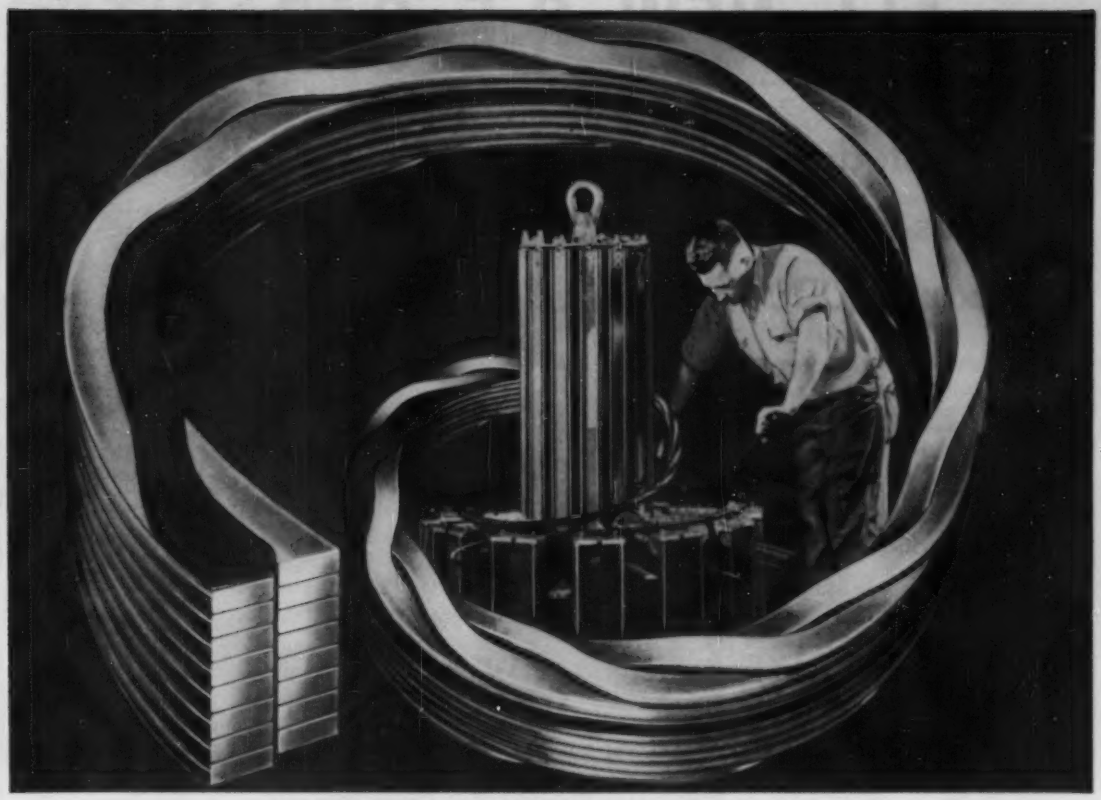
Equipment needed to make the gin includes a truck rated 1½ tons or larger equipped with a standard A-frame and winch; two snatch blocks and slings; three rachet chain binders; and one 30-, 35-, or 40-ft pole. The pole should be of proper class to provide strength and safety for loads desired.

To set-up the mobile gin pole the A-frame is raised and adjusted to proper position. For heavy materials the gin should be almost vertical. By measuring the height of the A-frame, the gin pole can be hooked so it will be held in exact position wanted when raised with the winch line.

The butt of the pole is rested on trailer hitch and secured to the rear of the truck with a chain binder. Then a lineman binds the pole to the top of A-frame with two binders, hangs a snatch block to the top of the gin, and changes the winch line from the A-frame to the snatch block.

Three men are recommended to set-up the equipment, which will require about 30 min.

(*More How To on page* 90)



G-E CURRENT-LIMITING REACTORS have continually transposed rectangular conductors that result in a better conductor space factor.

5 good reasons for buying G-E reactors

1. **LONG LIFE** Non-aging concrete supports maintain proper electrical clearances between turns. General Electric reactors do not rely on conductor coverings of aging types for turn-to-turn insulation.

2. **COMPACTNESS** Rectangular transposed conductors, an exclusive G-E feature, permit better conductor space factor—decrease volume of reactor by as much as 20%. Reactors fit in smaller places, save floor space.

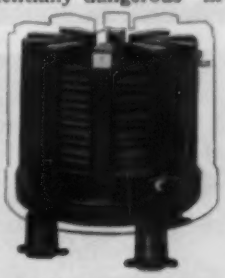
3. **PROTECTION** Non-aging glass tape on the conductor serves as a barrier to prevent foreign objects from causing turn-to-turn short circuits.

4. **AVAILABILITY** Thanks to our "repetitive-manufacture" production methods, we can meet any reasonable reactor shipment requirements.

5. **ECONOMY** Save 10% by specifying reactors with aluminum conductors. The same high-quality performance standards will be obtained as with copper conductors.

HERE ARE ADDITIONAL FEATURES:

Wet steam curing of concrete assures full strength at shipment—eliminates potentially dangerous "in-service" curing. Black phenolic varnish finish is smooth, flameproof. Metal housings, complete with entrance and exit provisions, minimize stray currents and protect personnel.



G-E Reactors are Smaller

For full information, contact your nearest G-E Apparatus Sales Office or write to General Electric Company, Section 422-17, Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

ALL NEW G-E CAPACITOR

Field-tested assembly over *50* percent stronger handles one or two copper or aluminum lines; exerts 1000 lbs. contact pressure through corrosion resistant connector.

Every General Electric outdoor capacitor with glass bushings now has a stronger terminal that's far easier to handle.

Here are the details that give this sturdy new terminal its practical advantages:

1. Conductors can be quickly inserted in the assembly without threading. **2.** One or two copper or aluminum conductors from No. 10 AWG solid to No. 2 AWG stranded can be clamped securely. **3.** Two Belleville washers exert a constant pressure of over 1000 pounds, forcing the parallel-groove connectors to follow the cold flow of aluminum. **4.** The hex nut will strip without damaging the terminal stud if excessive tightening torque is applied. It can easily be replaced with a new nut. **5.** Accidental loss of this nut is reduced because the top threads on the terminal stud are staked. Yet, if necessary, the nut can be forcefully removed. **6.** The parallel-groove connector is tin-plated to provide good conductivity and minimize corrosion.

Every element of this design has produced a strong and dependable terminal assembly requiring a minimum of time and effort to connect. Ask your G-E Apparatus Sales Engineer for more information. General Electric Company, Schenectady 5, New York. 48-23

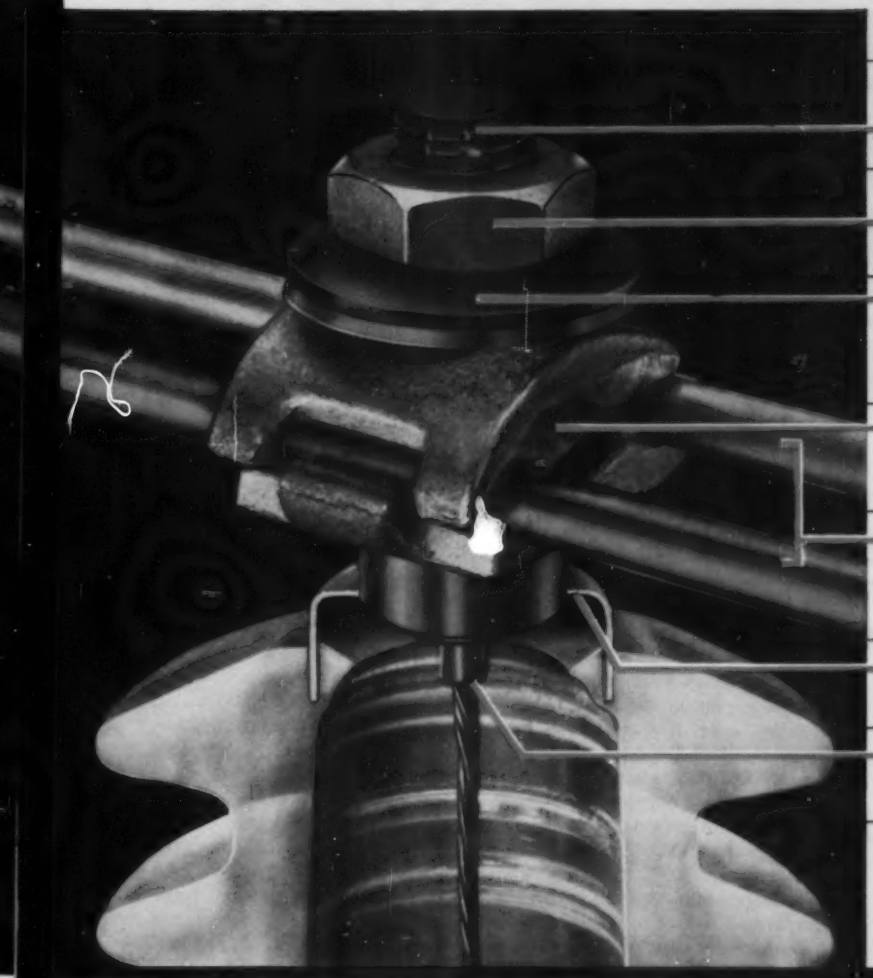
Progress Is Our Most Important Product

GENERAL ELECTRIC

NO THREADING of conductors is needed with parallel-groove connector. Loosen nut and conductors slip in place.

BELLEVILLE WASHERS maintain over 1000 pounds contact pressure on connector. Flat washers indicate proper torque.

TERMINAL *at no price increase!*



STAKED THREADS
keep assembly from being accidentally removed

NUT STRIPS FIRST
if excess torque is applied, avoiding damage to stud

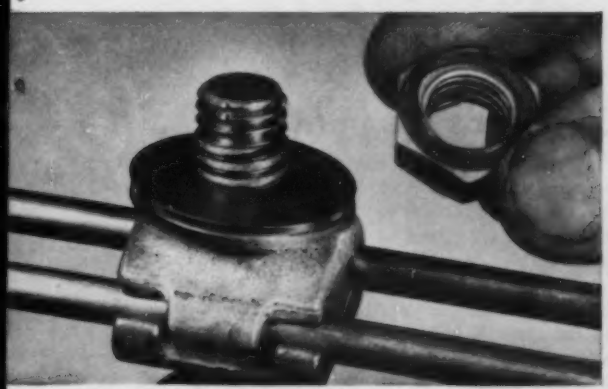
POSITIVE CLAMPING
with Belleville washers follows cold flow if aluminum conductors are used

TIN-PLATED CONNECTOR
provides good conductivity and minimizes corrosion

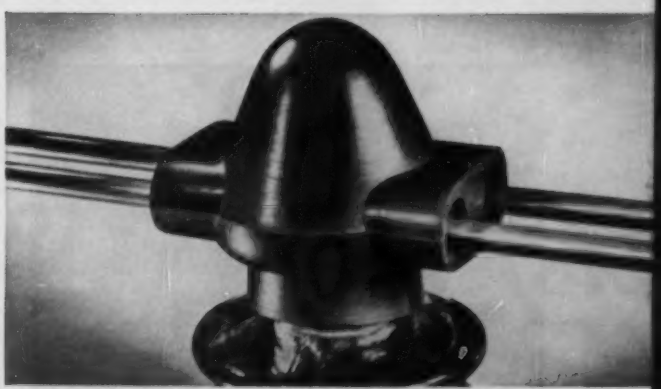
HOLDS 1 OR 2 AL OR CU CONDUCTORS
from No. 10 AWG solid to No. 2 AWG stranded

PRESSURE-BRAZED TO CAST-IN-GLASS FLANGE

CRIMPED AND BRAZED LEAD-WIRE CONNECTION



NUT STRIPS BEFORE THE STUD, preventing damage to stud threads due to excess torque. Nut can easily be replaced.



PROTECTION against birds and rodents is provided by this rubber cap which fits securely over the entire assembly.

RECLOSER AND SECTIONALIZER MAINTENANCE REPORT

___Recloser ___Sectionalizer	Manufacturer	Type	Serial No.	Amp.	Voltage	Number of Operations		
						Fast	Delay	Extra Delay

Pole No.	Location	Line Voltage	Short Circuit Amps.	Reason for Inspection	Date Inspected

	As Found	As Left
(1) Oil Level	(1) Normal___ Low___	(1) Normal
(2) Oil Condition	(2) Good___ Carbon___ Water___	(2) Replaced___
(3) Gaskets	(3) O.K.___ Deteriorated___	(3) As is___ Replaced___
(4) Contacts	(4) Good___ Slight burning___ Heavy burning___	(4) As is___ Dressed___ Replaced___
(5) Bushings	(5) O.K.___ Dirty___ Broken___	(5) As is___ Cleaned___ Replaced___
(6) Tank Liners, Fiber Bakelite	(6) O.K.___ Warped___ Moist___	(6) As is___ Replaced___ Dried Out___
(7) Elec. Connections	(7) Tight___ Loose___	(7) As is___ Tight___
(8) Operation Test	(8) O.K.___ N.G.___	(8) O.K.___
(9) Counter	(9) O.K.___ N.G.___	(9) O. K.___ Replaced___
(10) Min. Pickup Current	(10) _____Amps.	(10) _____Amps.
(11) Insulation Breakdown Test	(11) O.K.___ N.G.___	(11) O.K.___
(12) Counter Reading	(12) _____	(12) _____
(13) Operations since last inspection	(13) _____	

REMARKS: _____

Maintenance Form Insures Complete Recloser Inspection

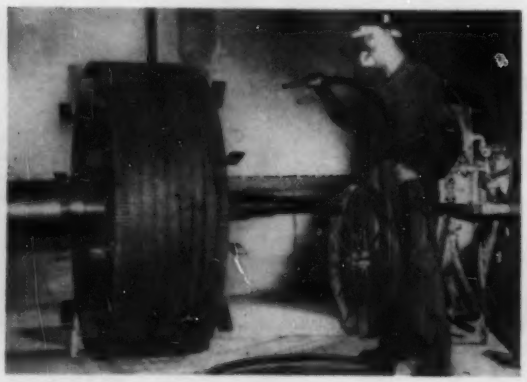
W. M. PHILLIPS, Engineer, Distribution Dept, Ohio Power Co, Canton, Ohio

A maintenance form expedites and insures complete checking of reclosers and sectionalizers by shop or field personnel. After a complete file of these reports is accumulated, excellent data will be available on the dependability and life expectancy.

Maintenance program in the Central Division currently calls for complete shop overhaul of sectionalizers every three years because moisture collects inside them. But reclosers are overhauled after 100 operations or three years, whichever occurs earliest.

To facilitate the inspection a check form was made up on an 8½ x 11 in. sheet with space provided below for remarks, inspector's signature, and where to send report. By listing all items and providing space for check marks writing is kept to a minimum. The heading may be filled in by using either the distribution department's records or data on the equipment name plate, but records should be checked against name plate. The pole number, location, line voltage, short-circuit amperes, and reason for inspection are furnished by the distribution department. Items should be added for inspection of fiber or bakelite parts and drying moisture is found.

Item 2 in "As Left" column should not leave any alternative to replacing oil when sectionalizers or reclosers are removed for maintenance.

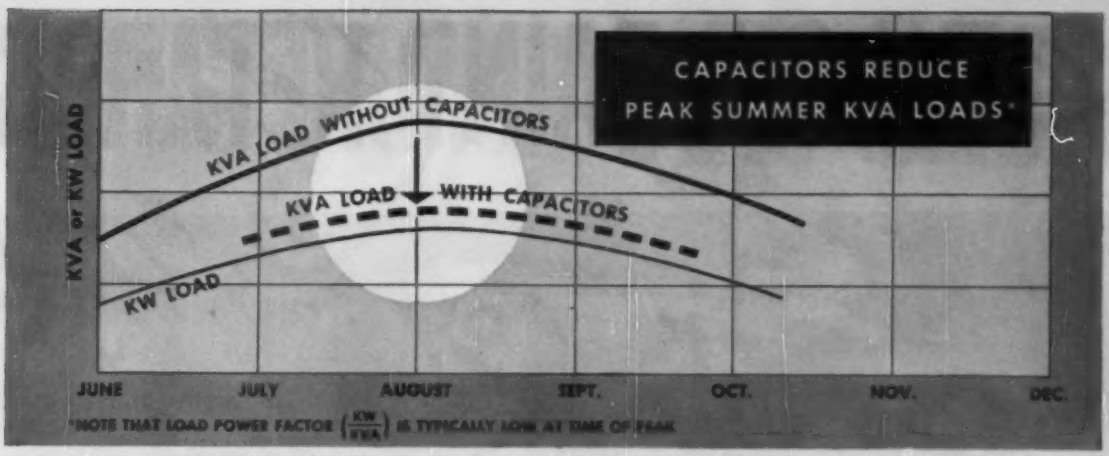


Corn Cobs Clean Motors

Ground up corn cobs are used as both an abrasive and absorbent in air blast cleaning of industrial equipment at Westinghouse Electric Corp's Chicago plant. This treatment has the advantage of removing foreign matter without it getting into inaccessible places.

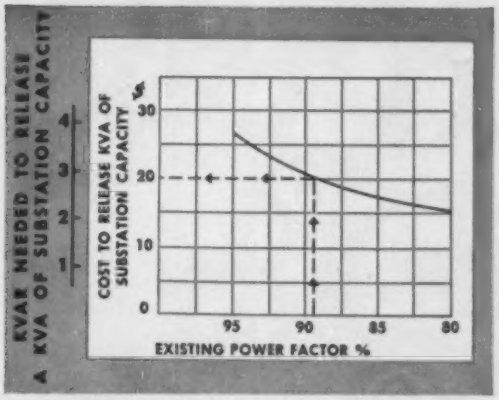
A 50-lb bag of corn cob particles, reduced to the size of lake sand, lasts 20 min on an average cleaning job, and the material is highly reclaimable. More than 200 motors, were cleaned in this manner recently following the recent flood.

(*More How To on page* 98)

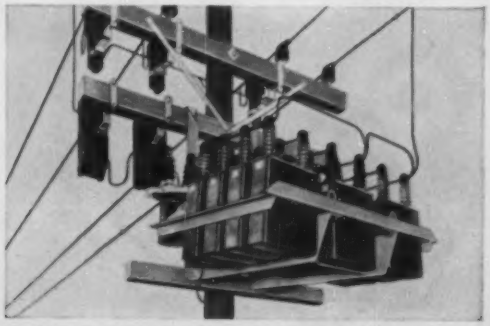


SUMMER PEAKS equaled or exceeded those of December in approximately 50 utilities last year, and these are low-power-factor peaks as shown above—a direct result of increased air conditioning loads.

Utilities report: G-E capacitors solve summer load problems economically



WHAT IT WILL COST YOU to lower your peak summer load with capacitors. At 89% power factor, about $20 of primary capacitors will release one kva of system capacity.



AUTO-SWITCH CAPACITOR EQUIPMENT quickly and easily installed requires minimum connections for energizing, and offers selection of either crossarm or direct-to-pole mounting.

Relieve overloaded equipment—release a KVA of system capacity for only $15 to $25

During summer months, low-power-factor air-conditioning loads create a serious problem for utilities—particularly those in warmer climates. The high kilovar content of these loads overloads transformers, causes excessive voltage drop and high power losses.

CAPACITORS—THE PRACTICAL SOLUTION

Capacitors are widely accepted as the economical solution to this problem. Installed in fixed and switched banks on distribution substation busses or outlying distribution poles, capacitors reduce KVA loading of substations and overhead lines. And the switched capacitors can help regulate voltage—keep voltage up right out to the ends of feeders.

BENEFITS FROM CAPACITORS

1. Capacitors allow two to three times more load to be carried on voltage-limited circuits.
2. Capacitors release thermal capacity—permit substations to carry more kilowatts.
3. Capacitors often pay for themselves out of savings resulting from reduced system losses.

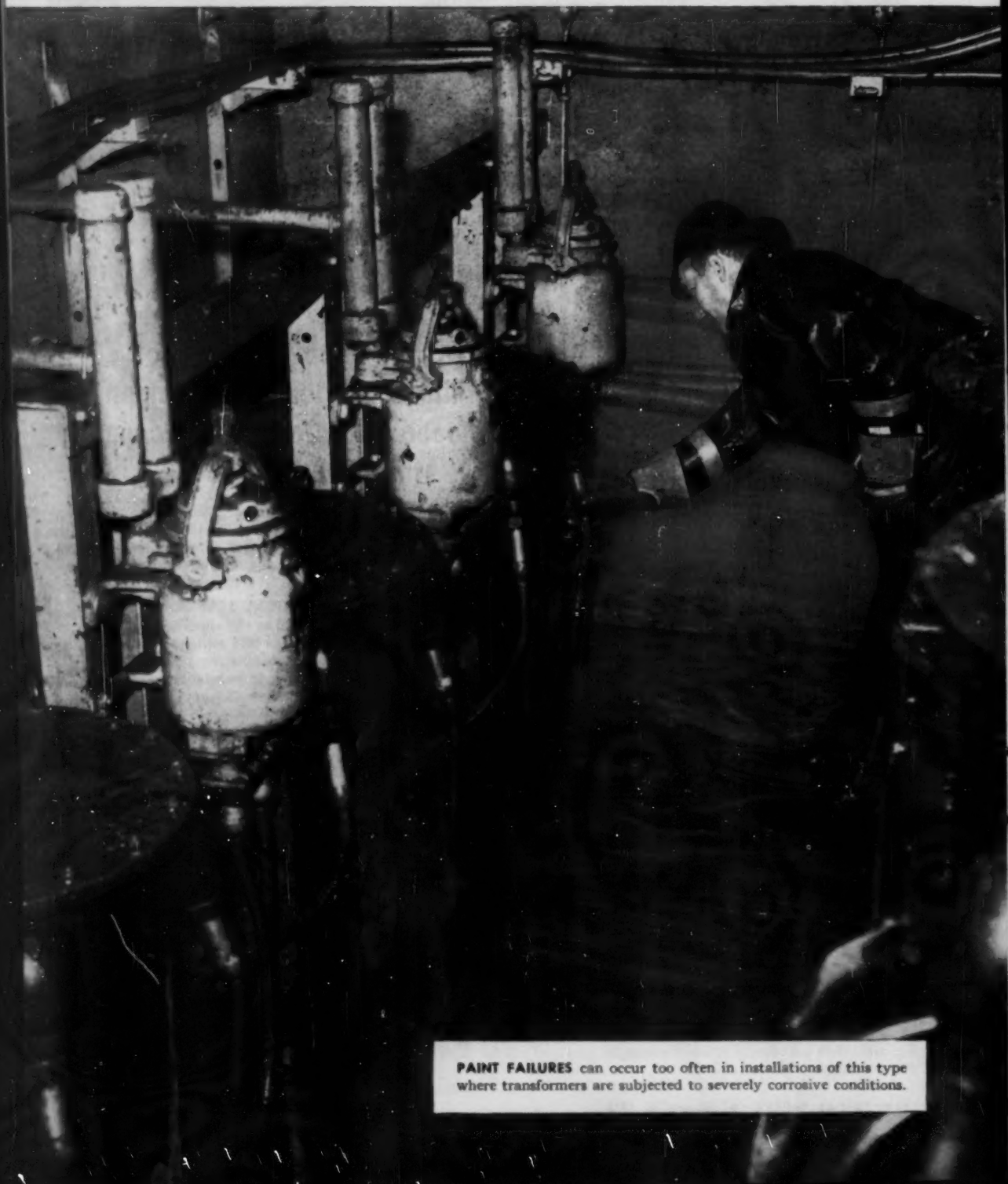
IF YOU HAVE A SEASONAL LOAD PROBLEM

If you have a seasonal load problem, it will pay you to investigate General Electric switched capacitors. For full information, get in touch with your G-E Apparatus Sales representative. *General Electric Company, Schenectady 5, New York.* 46-4

Progress Is Our Most Important Product

GENERAL ELECTRIC

NEW G-E PAINT RETARDS



PAINT FAILURES can occur too often in installations of this type where transformers are subjected to severely corrosive conditions.

TRANSFORMER CORROSION

MELAPRENE --- a new synthetic rubber finish --- protects G-E subway transformers from water, sewage, acids, calcium chloride

General Electric Melaprene finish lasts as much as 3 times longer than conventional coatings . . . brings substantial reductions in maintenance costs

At $100 a transformer—and that's a conservative estimate—the cost of removing and repainting subway units can run into thousands of dollars a year. You can substantially cut this expenditure by installing G-E subway transformers, now protected against corrosion with a new synthetic rubber finish, Melaprene. Two coats of Melaprene are applied on top of the present G-E subway finish.

Melaprene has extra-long life because it withstands the corrosive elements which run through ventilating grills onto your subway transformers. Melaprene is highly resistant, for example, to calcium chloride (now used in many cities for melting snow on streets), sewage, acids, and seawater, especially important in locations where tides may flood your subway vaults.

Durability of Melaprene is as much as 3 times greater than other paints. Melaprene test samples are still in top-notch condition after 5000 hours exposure in an accelerated salt-spray test. The best subway transformer finish previously available stands up only 1600 hours under this test. This improvement is a direct result of developmental work in G-E laboratories.

STRETCH TEST demonstrates strength, continuity, and freedom from porosity of the Melaprene paint film. Applied in two coats on top of the standard G-E finish, this new synthetic-rubber paint gives extra protection against corrosion.

For complete information on G-E subway transformers, now protected against corrosion with Melaprene, contact your nearest General Electric district office or write Section 431-27, General Electric, Schenectady 5, New York.

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GENERAL ELECTRIC

Reactance Method Used to Calculate Short-Circuit Current Produced by Motors

W. P. KOPPENAAL, Industrial Power Engineering, General Electric Co, Schenectady, N. Y.

Reactance values can be used to calculate the short-circuit current contributions of motors for the purpose of determining momentary and interrupting duties of circuit breakers and fuses.

On industrial plant distribution systems, generally a large portion of load is motors. When a short circuit occurs, each operating motor will contribute to the short-circuit current. Current initially has same order of magnitude as locked-rotor current. Decay in the magnitude can be assumed as resulting from a variable motor reactance.

For most industrial applications, two values of motor reactance to be considered are: (1) That value which governs the 1-cycle short-circuit current, and (2) that value which governs the 5 to 10-cycle current. These reactances are defined as follows:

1. Subtransient reactance, X''_d, is the apparent reactance of the stator winding at the instant short circuit occurs. It determines current flow during the first cycle.

2. Transient reactance, X'_d, is the apparent initial reactance of a stator winding if the effect of the amortisseur (squirrel-cage or short-circuited wound rotor) winding is neglected and only the effect of the d-c field winding is considered. This reactance determines the short-circuit current after a few cycles and up to about 10 cycles.

A synchronous motor has both of these reactances, since it has both a d-c field winding and an amortisseur winding. An induction motor has only subtransient reactance, since it has no direct-current field winding.

Reactance values for larger machines of recent design can generally be obtained from the manufacturer. Where specific information for older machines or for a large number of smaller machines is not available, the reactances can be estimated from nameplate data, or an average value used.

Subtransient reactance of a 3-phase induction motor can be estimated by the formula:

$$\%\,X''_d = \frac{\text{rated amperes} \times 100}{\text{full-voltage locked-rotor amperes}}$$

Typical values are in the range of 15% to 25%.

Percent reactances estimated from this formula or the tables are on the base kva of the motor, or on a base kva equal to the kva of all the motors in a group. These values should be converted to the common base kva of the short-circuit study. The base kva of a 3-phase motor or of a group of 3-phase motors is:

$$KVA_B = \frac{\text{rated volts} \times \text{rated amperes} \times 1.732}{1000}$$

or approximately = 1.0 × horsepower rating (for induction motors and 0.8 p.f. syn. motors), or 0.8 × horsepower rating (for 1.0 p.f. syn. motors)

Whether a motor is running at full load or at reduced load makes no difference as far as the magnitude of short-circuit current is concerned. Since it is quite common in industrial plants to have more kva of motors connected to the system than there is kva of generation or substation capacity, the base kva for a group of motors may be larger than the base kva of the supply source.

Examples

1. Occasionally recognition of the increased short-circuit current reveals that a circuit breaker or fuse selected on the basis of a generator or substation contribution alone would not be adequate. For example, a 225-kva, 3-phase, 4160-240-v substation transformer can contribute up to 13,000 amp to a short circuit on one of the 240-v motor feeders. This alone would indicate that a 15,000-amp circuit breaker would be adequate for a feeder breaker. However, induction motors on the other motor feeders from the same transformer would contribute up to 2,700 amp to the short circuit, making a total of 15,700 amp. Obviously the 15,000-amp breaker would not be correctly applied.

2. Another example shows the effect of motor contribution on the selection of a 2,400-v circuit breaker. A 7,500-kva, 13.8-2.4-kv transformer feeds an induction motor load from the 2,400-v bus. The transformer alone contributes 88,000 kva to a short circuit and corresponds to 34,000-amp momentary current. On this basis a 2,400-v, 100,000-kva, 40,000-amp momentary breaker could be applied. The induction motors, however, contribute an additional 15,000 amp to the momentary duty making this total 49,000 amp. The duties then are 88,000 kva for interrupting and 49,000 amp for momentary. The breaker to select would be rated 2,400-v, 150,000-kva, and 60,000-amp momentary.

Table 1—Motor Reactances

(To Use In Short-Circuit Calculations)

Motor Voltage	Short-Circuit Quantity	Reactance to Use: Synchronous Motors	Reactance to Use: Induction Motors
Above 600 v	1. Momentary current	1. Subtransient	1. Subtransient
	2. Interrupting kva or current	2. Transient	2. .....
600 v and below	Momentary or Interrupting current	Subtransient	Subtransient

Table 2—Typical Synchronous Motor Reactances

(For Individual Motors of 300 hp or More)

Motor Speed	% X''_d Range	% X''_d Most Common	% X'_d Range	% X'_d Most Common
900 rpm.....	7–16	10	10–22	15
514–720 rpm.....	11–22	15	17–36	24

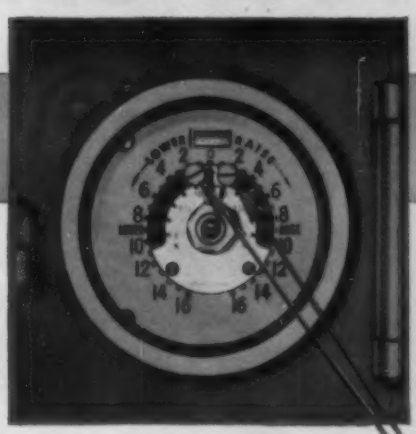
Table 3—Assumed Motor Reactances

(Equivalent Reactances For Groups of Small Motors)

Item	Motor Rating	% X''_d	% X'_d
1	600 v & less—induction*.....	25	..
2	600 v & less—synchronous*.....	25	33
3	Above 600 v—induction*	20	..
4	Above 600 v—synchronous*.....	15	25
5	600 v & less—induction†.....	31	..
6	600 v & less—synchronous†.....	31	39
7	Above 600 v—induction†.....	26	..
8	Above 600 v—synchronous†.....	21	31

* Items 1 to 4 include motor leads
† Items 5 to 8 include motor leads and step-down transformers

Here's what we mean by SIMPLE!



To change the ratings on this regulator, just move two limit switch pins

DO A WEEK'S job in minutes! With the *Vari-Amp* feature on Allis-Chalmers single-phase power regulators only three simple steps are needed to change ratings.

All you do is (1) open the position indicator window, (2) place the "raise" and "lower" limit switch pins in desired positions, and (3) close the window. That's all there is to it! No need to take regulator out of service. No electrical connection to make. No complicated adjustments or wiring. All other single-phase power regulators require 10 complicated, time-consuming operations to change windings.

Get Five Ratings in a Single Unit

With Allis-Chalmers single-phase power regulator you get five ranges of operation instead of the usual two. In most cases, initial cost is lower because of this flexibility. And, you can increase capacity with only a proportionate decrease in range of regulation. The *Vari-Amp* feature also provides extra short-circuit capacity.

Get complete facts on the convenience, flexibility, and reliability of Allis-Chalmers single-phase power regulators. Call your nearby Allis-Chalmers office or write Allis-Chalmers, Milwaukee 1, Wis., for Bulletin 01B6065C.

A-4462

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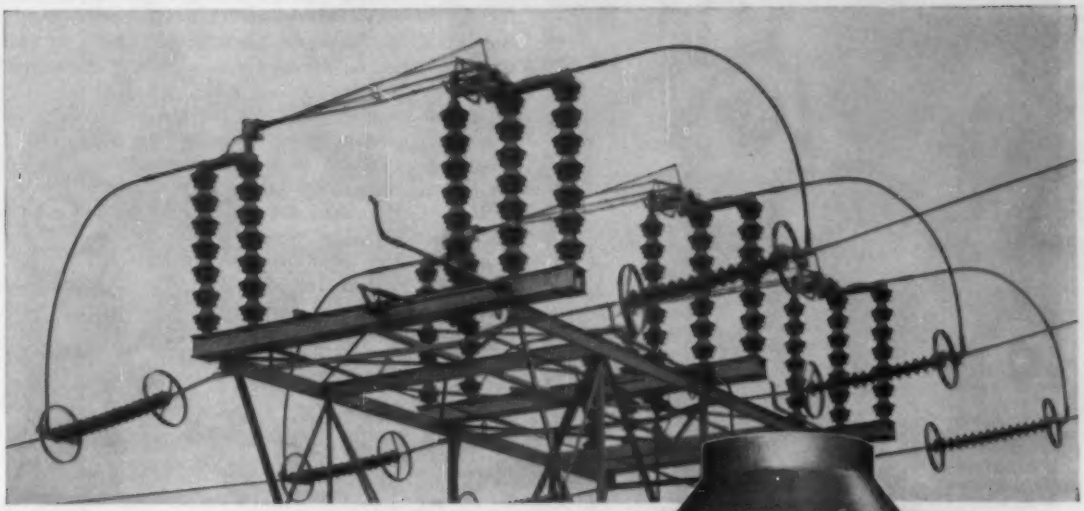
1920 35 1955 YEARS OF SERVICE TO THE ELECTRICAL INDUSTRY

★ PINCO INSULATORS ★

POINT TO "STACKS" PROVE ITS CASE, TOO!



• PINCO 735'S STACK UP AS WINNERS OF EVERY TRIAL

The minute an Apparatus Insulator goes into service, it faces the constant challenge of mechanical, thermal and electrical stress. Can any unit win . . . in every case?

Pinco 735's can . . . AND DO! For in millions of service years, Pinco seven unit stacks on all voltages, including 230 KV in widely varied applications have proved their superiority . . . proved to be *"RIGHT-ON-THE-JOB"*!

The reasons for their splendid record of trouble-free performance is no accident. It is because Pinco 735's are designed and built to test far beyond strength requirements. Rated at 7000 lbs., they consistently test at 25% beyond this rating. In laboratory tests, this unit breaks the bolts or pin base. The extra built-in strength plus accuracy to 3/10,000 of an inch of parallelism in jig assembly, reduces the possibility of deflection under stack loading . . . assures positive switch operation every time.

The next time your requirements call for Apparatus Insulators . . . specify Pinco 735's . . . to be sure!

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● *featuring rugged porcelain and a larger second shell plus improved center construction to provide additional leakage protection and increased mechanical strength.*

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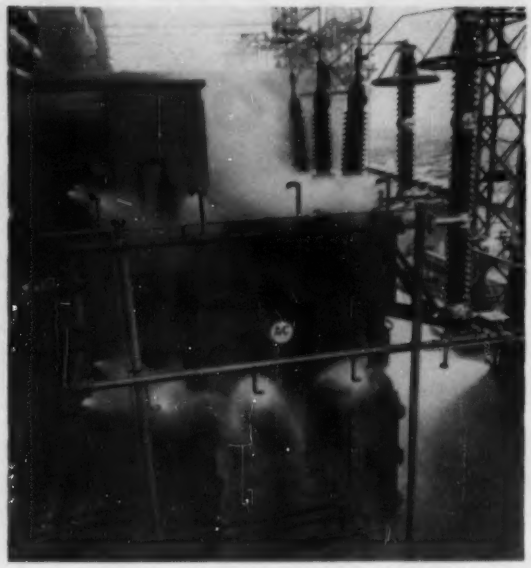
Fog System Protects Equipment at Eastlake Power Plant



Blaw-Knox Co Photo

Fire protection systems guard more than a half-million dollars of equipment at the Eastlake Plant of Cleveland Electric Illuminating Co. Supplied from Lake Erie, the water fog systems spray more than 2,200 gpm of water from 90 nozzles.

Three identical fog systems are used at the station. The system shown protects a 150,000-kva main transformer; a 138-kv, 10,000 Mva IC, 3-cycle circuit breaker; and two 6,000/7,500-kva station transformers. In addition, protection is provided for a starting transformer and two 5,000-gal oil storage tanks.

Lake water is drawn from the station service water lines with normal 175-psi pressure. It is retained at deluge valves located above the turbine floor and inside the station, immediately behind each transformer group.

Water is released by any one of a series of rate-of-rise heat-actuated devices which electrically open deluge valves when temperature rise is from 15 to 20F per min.

Individual control is provided for each main transformer, pair of station transformers, and circuit breaker. Each system normally operates thermostatically but in an emergency can be operated manually from two locations—break glass stations on transformer deck and at deluge valves inside the station.

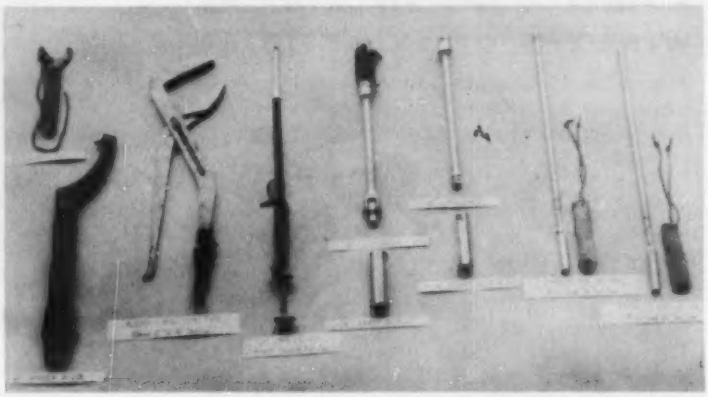
Tools Developed for Adjusting Street Lighting Transformers

E. C. HERSAM, Division Electrical Supt,* Coast Valleys Division, Salinas, Calif.

GEORGE A. ROSE, General Foreman, Electric Dept, Pacific Gas & Electric Co, San Mateo, Calif.

Constant-current street lighting transformers may be adjusted from above the oil level while rubber gloves are worn with a special set of tools developed by the authors. Use of the tools in the field will, in many instances, eliminate the need to lower the transformer below the "contact" area for adjustment. Also, the tools will protect the rubber gloves from contact with the oil.

The set consists of a 10-in. flexible handle (½ in.) and 10-in. flexible handle extension; a 1⅞-in. socket deep (½ in.); a 11/16-in. socket deep; and a 15-in. grip-it tool. Also included are two magnetic pick-up tools, with a 24-oz lifting power and sliding handle that allows the length to be varied from 16½ to 27 in.; one pair of pump-type pliers, with jaw openings from 2 in. to 7⅛ in.; a ¾-in. spanner fork; and a 6-in. spanner wrench (outside).



COMPLETE SET of tools allows adjustment of constant-current street lighting transformers from above the oil level. Tools are carried in a canvas bag for convenience and to protect them

Buckskin throngs are attached to all tools to prevent their loss in the transformer tank. The flexible handles and sockets are used to handle the "hex" nuts on the weight studs of the older type of constant-current transformer. After the nut is loosened and backed off for some distance, the grip-it tool is used to remove the nut. This tool also is used to start the nut on the studs. The magnetic pick-up tools are used to install and remove the weights in the transformers.

The pump-type pliers are used to loosen or tighten the jam nut that holds the large 6-in. diam weight found on some of the later types of transformers. It also is used to adjust the position of the weight. The spanner fork and the outside spanner may be used to loosen the jam nut. However, the authors have not yet found a jam nut that could not be loosened by use of the pliers alone.

(*Continued on page* 100)

*Prior to his present position, Hersam worked in San Mateo where he co-developed the tools.

Father reads the paper by candlelight tonight!

Reading the evening paper by candlelight is no joke. When bad weather brings down distribution lines, customers' blood pressures go up and loads drop. Public relations programs suffer correspondingly.

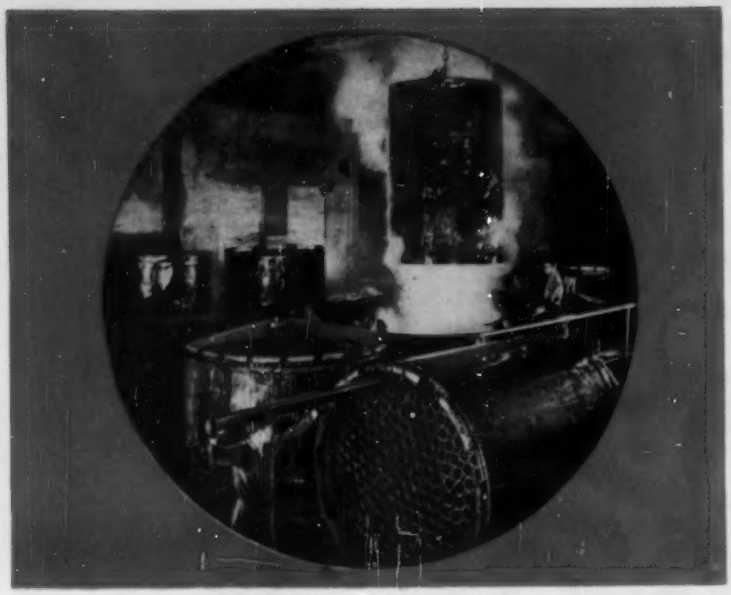
That's why weatherproof line wires in utility distribution systems are being replaced by messenger-supported, insulated aerial cables. These cables will operate safely and dependably even with broken poles.

Simplex Aerial Cables use Anhydrex insulation for long-lived physical properties, and for mechanical and electrical stability in water. Simplex-compounded neoprene provides a lightweight, tough jacket that withstands prodigious punishment.

To minimize the chance that father will read his paper by candlelight tonight, or any night, investigate messenger-supported, Anhydrex-insulated, Simplex Aerial Cables. Write today to the address below for Catalog No. 1006.

Simplex WIRE & CABLE CO.

79 Sidney Street, Cambridge 39, Massachusetts



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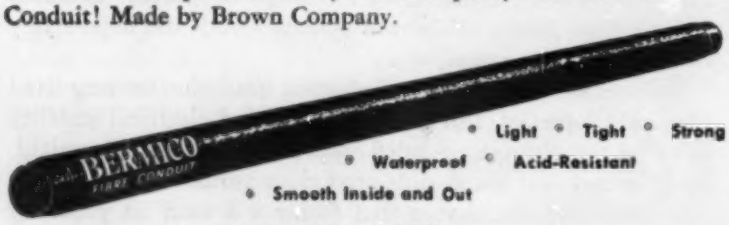

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Transformer Tools

(*Continued from page* 98)

Cost of the complete set of tools is about $26. The set is carried in a canvas bag for convenience at the top of the pole and to protect them when stowed in the service truck.

Old Cutouts Sectionalize Series Street Circuits

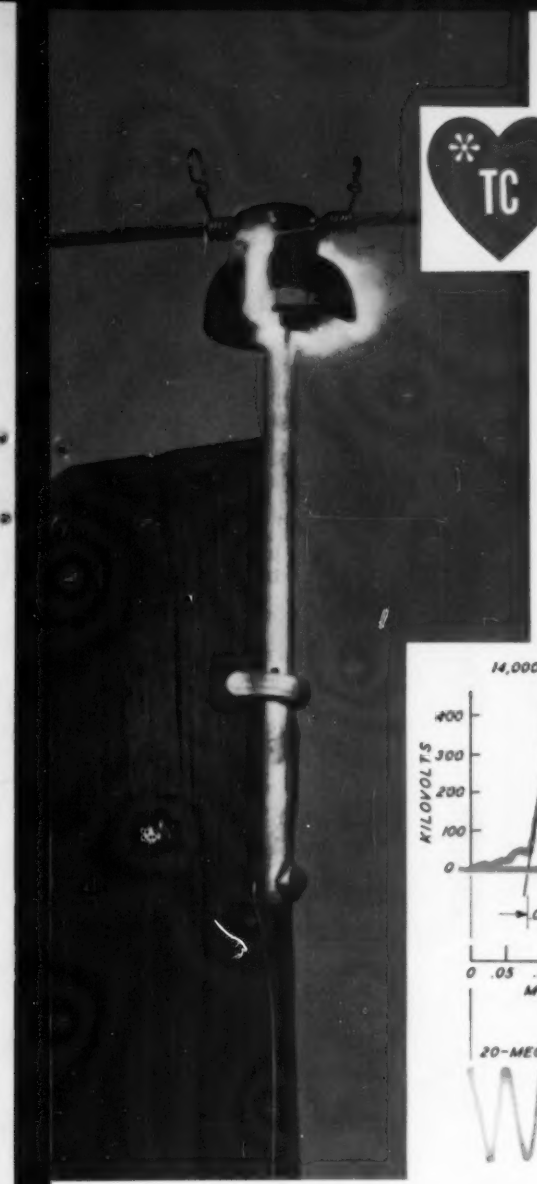
CHARLES KELLER, Superintendent, Underground Dept, Toledo Edison Co, Toledo, Ohio

Old 4-kv cutouts are being reused by Toledo Edison Co's underground crews for sectionalizing street lighting circuits. The cutouts are installed where the circuit changes from overhead to underground.

In the past, when work was to be done on the underground portion of the circuit, it was necessary to climb the pole and disconnect that portion of the circuit from the overhead system. Such "hot" work required two men.

Cutouts are now installed about 18

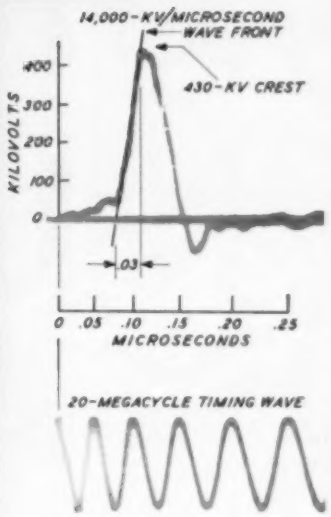
(*Continued on page* 105)



How Lightning-Immunity Was Engineered Into O-B Pintype Insulators

Today's dense network of rural and primary distribution lines, using pintype insulators, naturally results in almost universal lightning exposure, due to the general absence of efficient ground wire protection on such lines. The smallest insulator leads the most hazardous life.

Something important has happened to this insulator in recent years. To bring the story to life, we present the facts in documented form with an un-retouched photograph and an oscillogram from the O-B High Voltage Laboratory. By methods described later, it was determined that a wave-front of 2,000 to 5,000 kv per microsecond simulates the damage produced by natural lightning. The O-B Number 38148 pintype in our picture is receiving its *fourteenth* shot of impulse voltage, not with mere lightning intensity, but with a wave-front exceeding 14,000 kv per microsecond, at which it flashed-over in 3/100 of a microsecond at 430 kv. The mere attainment of this ultra-steep test wave plus the ability to read and record it is a notable piece of laboratory technique. The ability to withstand repeated shots of such intensity accounts for the remarkable service records of O-B pintypes.



Typical ridge-pin construction using O-B Number 38148 pintype insulator, withstanding its 14th shot of what may be one of the steepest test impulse waves ever produced -- a front exceeding 14,000 kv per microsecond! Laboratory data on this discharge is presented in the accompanying oscillogram of the test. Excellent evidence exists to back the statement that this phenomenally-steep man-made wave front exceeds, by approximately three times, the rate of voltage rise typical of natural lightning.

True, it is possible for *any* pintype manufacturer to engage an independent laboratory to run such a test, providing the special test equipment and ultra-steep-wave experience could be located. This could guide technical development directed toward lightning-immunity. But how could later checks be made? Sampling production *once* doesn't imply perfection ever afterwards and no lesser routine test can be correlated with steep-wave impulse performance. This is an example of what the O-B laboratory means to the O-B user -- the ability to check and re-check; and the equipment and knowledge to do it, not only properly but authoritatively. This may best be borne out by quoting from AIEE Paper 53-257, "Puncture Tests on Porcelain Distribution Insulators Using Steep-Front Voltage Surges" by Park and Cones of National Bureau of Standards, where in the closing paragraph it reads: "Acknowledgement is also made of the pioneer work done in this field by the Ohio Brass Company."

OHIO BRASS COMPANY, MANSFIELD, OHIO
In Canada—Canadian Ohio Brass Co., Lt'd., Niagara Falls, Ont.

Please turn the page for more of the story of how Technical Competence has been employed to build lightning-immunity into O-B pintype insulators.

TECHNICAL COMPETENCE the heart of every Ohio Brass insulator

Contributing To Your Sound Sleep

Every O-B pintype design from the smallest distribution size to the largest transmission unit, has been subject to steep-wave test investigation, followed by periodic laboratory confirmation. Years ago, this resulted in re-design of several units to attain a high uniform level of lightning-immunity.

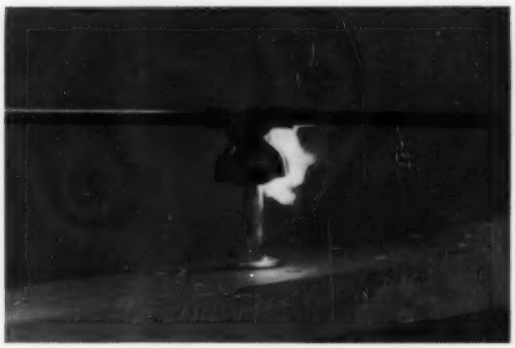
Multiple shots are applied to generous-sized groups of specimens picked at random from current manufacture. Field experience and observed lightning attack indicate the possibility of more than one discharge occurring over an insulator during its normal life. In a 30-storm-day territory (typical of large sections of the U.S.) a power line may be expected to receive one lightning shot per

. . . . . About The Photographs

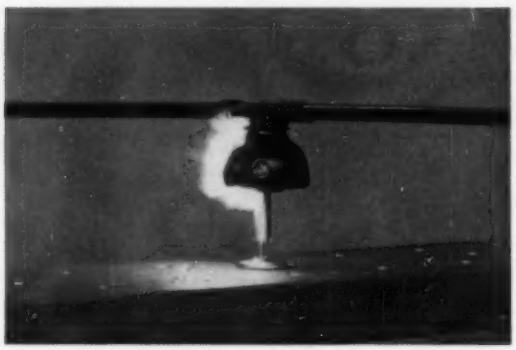
All pictures on these pages were made in succession during a routine ultra-steep-wave design test. Preceding statements concerning the 14,000-kv per microsecond rate of voltage-rise apply to the second picture in the series (Number 38148). This insulator was singled-out because it is a very popular unit whose usual 13-kv application subjects it to severe lightning exposure.

Flashover voltage and time to flash are indicated below each specimen. The corresponding rates of voltage-rise generously exceed the 5,000-kv per microsecond expected from natural lightning.

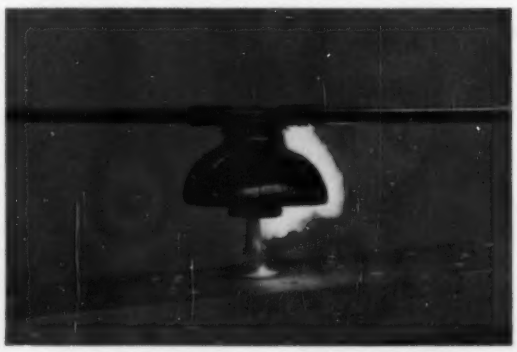
In every case, the pictures are single exposures. The split-arc flashover recorded on some specimens is entirely typical of the test.



Number 12847. Flashover, 350 kv at 0.02 microsecond.



Number 38148. Flashover, 430 kv at 0.03 microsecond.



Number 38151. Flashover, 480 kv at 0.04 microsecond.

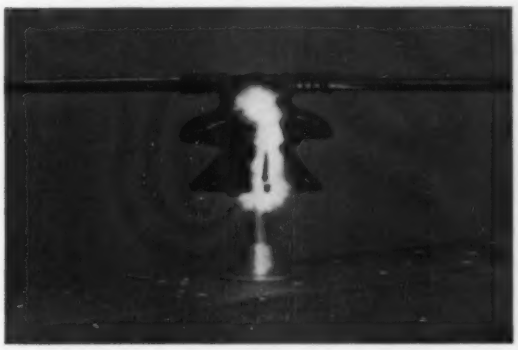
On A Stormy Night

year, per mile. Assuming 18 structures per mile of distribution construction, it will be seen that multiple discharges over some insulators are a reasonable expectancy considering a line life of 30 years. For this reason we apply repeated shots in testing.

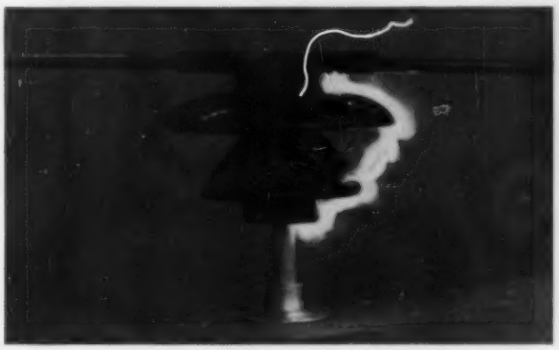
Even at 14,000 kv per microsecond -- possibly three times the voltage rise of natural lightning -- O-B pintypes show considerable resistance to destruction, with the only evidence of damage being scars over the face of the glaze, caused by the rapid release of such tremendous energy. At the customary test wave of 7,000 kv per microsecond (50 per cent above observed natural lightning) failure rates are negligible.

How does this laboratory experience tally with field results? With modern O-B pintype insulators, lightning-puncture which was once a major service hazard has now practically reached the "infinity point" of infrequency. *This valuable property is not common.* It is the result of three things: first, the conviction that pintype insulators could be made immune to lightning; second, the willingness of research engineers with the "blessing" of Management, to pursue such an involved problem; third, the possession of a laboratory and, more important, of a grade of men in that laboratory capable of doing pioneering work in advanced steep-wave phenomena.

This is how O-B Technical Competence has made its contribution to your sound sleep on a stormy night.

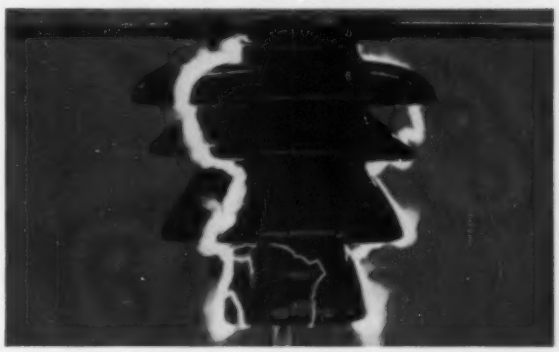


Number 38222. Flashover, 540 kv at 0.06 microsecond.



Number 38255. Flashover, 650 kv at 0.08 microsecond.

Number 38223. Flashover, 590 kv at 0.07 microsecond.

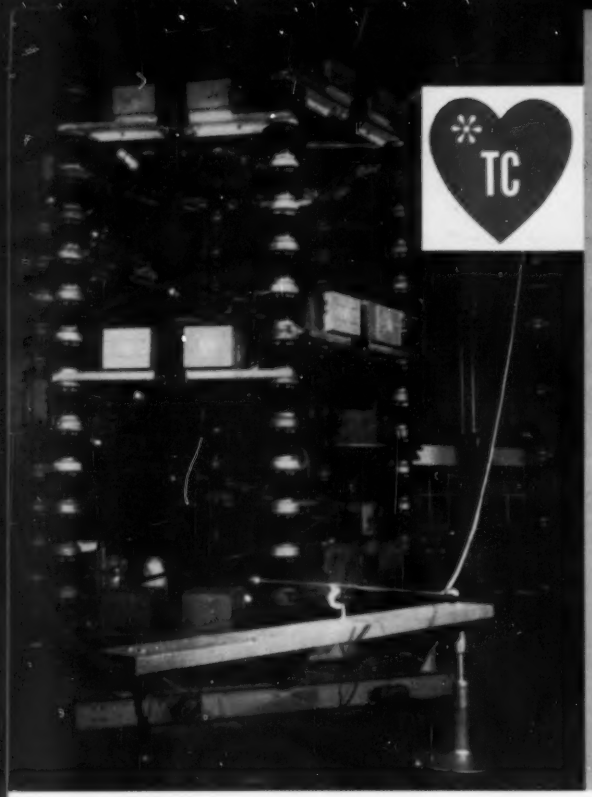


Number 38270. Flashover, 300 kv at 0.10 microsecond.

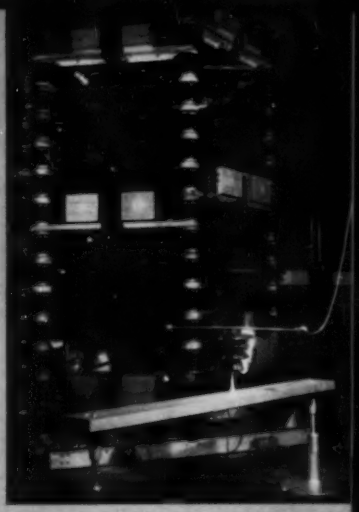
How did we put a yardstick on natural lightning?

TURN THE PAGE AND READ THE STORY - - -

TECHNICAL COMPETENCE the heart of every Ohio Brass insulator



Impulse generator in the O-B High-Voltage Laboratory used to conduct lightning investigations, and to make routine periodic checks on pintype insulator production. Portion of the generator in use has a capability of 2,000,000 volts. For conventional testing with a wave of 1½ x 40 microseconds, a section may be added containing additional banks of condensers, and raising the generator's voltage to 3,000,000. Mere voltage, however, is not the criterion of steep-wave test apparatus so much as extreme rates of voltage-rise combined with elaborate control and recording equipment.



Number 38148 pintype after receiving three shots at a voltage-rise of 14,000 kv per microsecond and flashing-over at 430 kv. While the glaze has been scarred, as shows in the picture, the unit is still perfectly sound after sustaining a voltage-rise approximately three times that of natural lightning.

How We Put A Yardstick On Lightning

Here was the question: Before conducting laboratory research on pintype insulators vs. lightning discharges, some evaluation of these natural discharges was necessary.

Since this research project goes back many years, it preceded present available knowledge of lightning characteristics. Such data is now being collected, little-by-little, by various excellent technical organizations. Unfortunately this does not even yet embrace rates of voltage-rise. However, when the word "pioneering" was attached to O-B's work, the expression was especially apt as we were required to evaluate lightning wave-fronts at a time when little information was available. After that came the problem of reproducing them.

There were in the field many pintype insulator designs, some vulnerable to lightning and some highly immune. Quantities of these, in undamaged form, were brought back into the laboratory. Additional new equivalents were drawn from stock. Performance records of these insulators were well-enough known so that a generous sample would provide a reasonably good laboratory standard. By painstaking and lengthy testing of these specimens, a wave-front was finally established that would duplicate average failure records in the field. Those that would fail in service would show a similar failure rate in the laboratory. Those that would withstand natural lightning withstood our test discharge level.

Intensity was then increased until units which showed no service failures began failing under test. It could be hypotheticated that we had exceeded the wave-front of natural lightning at this stage.

In this way we "bracketed" lightning with a set of known laboratory values. We had measured the voltage rise of lightning, if not with pin-point accuracy, at least in a highly practical sense. It was found that a rise of 2,000 to 5,000 kv per microsecond produced an average of failures corresponding to field experience. We raised this, arbitrarily, to 7,000 kv in our design research, thus inserting a conservative 50 per cent factor of safety.

Subsequent field experience covering many years and millions of insulator units has soundly confirmed our laboratory findings. Modern O-B pintype insulators can be relied upon to survive lightning attack with a good reserve.

Bear in mind, no other insulator has had the long-time benefit of the vast private laboratory facilities available to O-B, both in the design stage as well as in the all-important follow-up. Great extra value has been put into O-B pintypes by Technical Competence, the heart of every O-B insulator.

OHIO BRASS COMPANY, MANSFIELD, OHIO

In Canada—Canadian Ohio Brass Co., Lt'd., Niagara Falls, Ont.

TECHNICAL COMPETENCE the heart of every Ohio Brass insulator

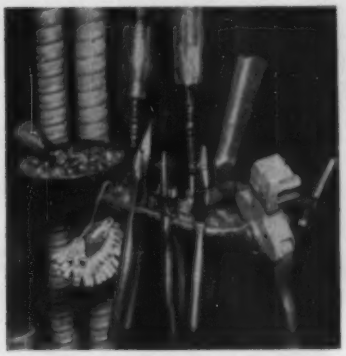
4510-H

Old Cutouts

(*Continued from page* 100)

ft above ground and can be operated by one man standing on the ground and using a long disconnect stick. The result is an appreciable saving in time.

While the discarded cutouts are not approved for 4 kv operation they are very satisfactory for this type of job.



WIREMAN'S TOOLS on toolholder are accessible when work is several feet above floor

Toolholder Aids Switchboard Wiremen

LEONARD W. HILL, Substation Dept, Indiana & Michigan Electric Co, South Bend, Ind.

A clamp-type toolholder provides a convenient place to keep a variety of specialized tools readily accessible for switchboard wiremen, especially when the work area is several feet above the floor. Experience has shown that the inexpensive toolholder aids work in the following ways:

1. Holds most-used tools within easy reach of the workman.

2. Keeps tools not in use away from energized portions of the switchboard.

3. Easily moved from one height or location to another by merely loosening the clamping screw.

4. Usable on practically all types of switchboard supports.

The simple toolholder was fabricated from an ordinary 3-in. forged steel C-clamp. Five holes were drilled in the bridge of the clamp to accomodate a variety of pliers and screwdrivers. Behind these holes, two long studs, screwed through the clamp,

NO. 6 IN A SERIES ON ASSURED POWER CONTINUITY

- - - - Why you must insist on a two position, inherently interlocked, single coil, mechanically locked automatic transfer switch

Properly designed transfer switches must maintain one of two positions:
1. NORMAL CLOSED, EMERGENCY OPEN. 2. NORMAL OPEN, EMERGENCY CLOSED.
Should both circuits be closed, a short circuit from system to system would develop. Should both circuits be open, obviously the load would be disconnected from the power supply.

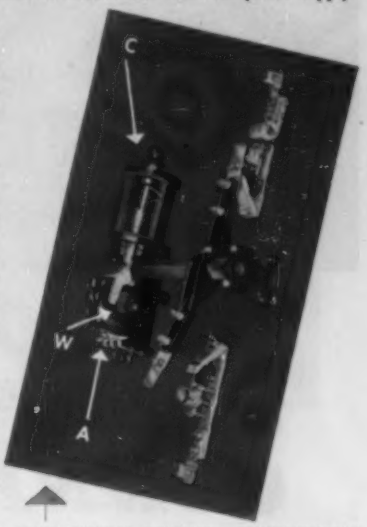
Warning! Any transfer switch providing a possibility of both normal and emergency contacts being open, or both being closed is a source of danger. It can produce the identical condition of power outage which the installation is designed to prevent—with subsequent panic, accident or theft.

ASCO *–designed double throw Automatic Transfer Switches provide only two possible positions—and are inherently interlocked. ASCO Transfer Switches assure power continuity.*

The design simplicity of a single coil—the positive action of mechanical locking offer further assurance of continuous power. High contact pressure minimizes contact I^2R losses. Power outages caused by vibration and other accidental contact openings are eliminated.

ASCO *Automatic Transfer Switches are of single coil construction and are mechanically locked—two more reasons why ASCO Automatic Transfer Switches assure power continuity.*

Compare. Then insist on an ASCO Automatic Transfer Switch.



1. ASCO NORMAL POSITION – *MECHANICALLY LOCKED.* Coil (C) de-energized. Compression spring fully extended. Rotating weight (W) at rest. Angular placement of connecting linkages locks weight and main contacts firmly in position. Movable and stationary circuit control contacts (A) are closed.

ASCO CHANGEOVER ACTION – Solenoid core moves into coil compressing spring instantly. Connecting linkage lifts rotating weight, breaking main contacts. Circuit control contacts next open solenoid coil circuit. Kinetic energy continues the motion imparted by initial solenoid pull. *Eccentric cam on weight raises the yoke (Y) which rotates contact shaft.*

2. ASCO EMERGENCY POSITION – *MECHANICALLY LOCKED.* Kinetic energy, accelerated by stored energy in compression spring, moves weight into final position. Movable and stationary contacts (B) are closed. Coil is again de-energized. Angular placement of linkages again locks weight and main contacts firmly. *The return of normal power causes counter operation.*

For more complete information write for the other advertisements in this series—and for Publication 502 which explains how to select Automatic Transfer Switches.

ASCO Solenoid VALVES

Automatic Switch Co.

397 Lakeside Avenue • Orange, New Jersey

ASCO Electro-Magnetic CONTROLS

DOSSON "F" SPLIT BOLT CONNECTOR

Fabricated from high strength alloys (better than average steels), the Dosson "F" is cold-formed for uniform quality. Maximum contact pressure is assured by a high translation of tightening torque. Full length pressure bars with rounded edges prevent load concentration and crushing of conductor. Built to withstand high overload, vibration. Highly corrosion resistant.

Mail coupon for FREE Dosson "F" Connector

DOSSERT MFG. CORP.
249 Huron St., Brooklyn 22, N. Y.

Gentlemen:
Please rush free sample Dosson "F" Split Bolt Connector plus catalog sheet.

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City_____

50 YEARS OF TECHNICAL KNOW-HOW

DOSSERT MFG. CORP.
249 Huron St., Brooklyn 22, N. Y.

hold spinner-type wrenches. A slotted piece of fiber held by one of these studs serves as a knife holder. A shallow metal cup fastened to one end of the clamp provides a convenient receptacle for small items of relay hardware. A notch filed in the stationary jaw of the clamp helps to hold it securely on pipe supports.

If desirable the clamp and tools can be coated with some tough insulating compound or something more resistant to impact. But it would be impossible to insulate the long screw threads unless they were made of fiber.

Portable Gun Carriage Aids Burner Changing

A. STRAMSKI, Chief Engineer, A. D. Ellis Mills, Inc., Monson, Mass.

A gun carriage has been built by the A. D. Ellis Mills, Inc, Monson, Mass., to facilitate handling fuel oil guns during the replacement of the guns in boiler registers. The truck measures 44 x 17 x 32 in. and is equipped with swivel casters, so one man can maneuver it easily.

On one end of the truck (left end in illustration) is a metal container to carry clear guns and solvent. A similar container on the other end carries the "used" guns.

The truck is used at the end of each eight-hour operating period during replacement of the guns for the two boilers, which are each rated at 250 psi, 500 F, and 35,000 lb of steam per hour.

Here's why Speedomax Instruments do a

Better Load-Telemetering Job

Today's growth of system load and system capacity places even greater premium on speed and accuracy of load dispatching. Quality of the dispatching job, however, depends to a considerable extent on the means used for telemetering load facts from all parts of the system to the system operator's office. Here are some of the reasons why major power systems select Speedomax Telemeters to do their data-gathering work:

OPERATIONAL FEATURES

Transmission Distance—Works with telephone, microwave or carrier channel, over any distance the channel can span.

Retransmitting and Totalizing—Speedomax can be supplied to retransmit, to integrate, to add up area generation, net interchange, etc.

Automatic Control—Speedomax Telemeters work directly with L&N Load-Frequency Control, and are engineered as an integral part of system control.

DESIGN FEATURES

Response—Choice of impulse or continuous types, depending on speed required for the application.

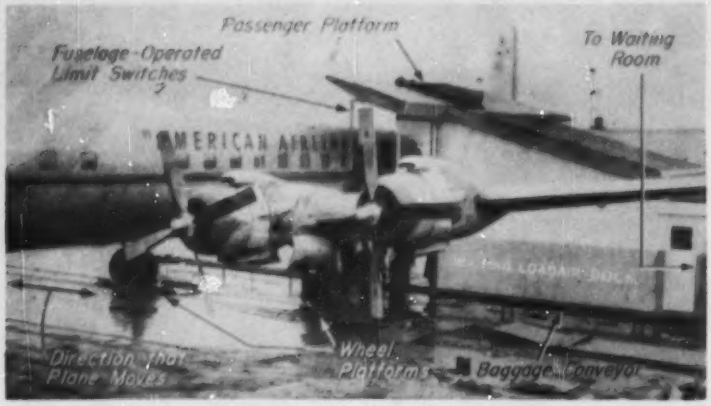
Accuracy—Reproduction of measurements is so faithful that transmitter and receiver charts are practically identical.

Self-Synchronizing—Transmitter and receiver automatically stay in step—can even operate from power sources at different frequencies.

Simplified Testing—Built-in checking facilities permit test and calibration of channel without meter tests.

For details, write to Leeds & Northrup Co., 4938 Stenton Ave., Philadelphia 44, Pa.

INDUSTRIAL APPLICATIONS



AIRPLANE LOADING and unloading is speeded by this electric dock. A 20-hp winch pulls the wheel platforms sideways until the airplane's door is next to the sheltered terminal platform. A conveyor (behind wheels) whisks luggage to claim area as it is unloaded. This picture was taken before the conveyor's belt, pulleys, and enclosure were installed

Electric Airplane-Dock Speeds Loading

A powerful electric winch has been developed to pull commercial airplanes close to the airport terminal building so that passengers need not dash through snow and rain to climb aboard.

The first experimental installation is now in service at Gate 4 of New York's International Airport. Other airports are expected to follow suit if the loading device meets expectations.

Designed for passenger comfort and to speed baggage handling, the Whiting Loadair installation consists of three parts:

1. An electric winch that pulls two small platforms on tracks. These platforms are for the plane's wheels.

2. An enclosed conveyor that runs from the plane's baggage compartment to the baggage claim desk inside the terminal.

3. A covered passageway with its passenger-loading platform flush with the airplane's door.

Here is how the installation works:

A plane arrives at the airport and taxis to its loading area. The pilot guides its wheels upon the winch platforms flush with the pavement. Attendants in the terminal jab pushbuttons, and the winch begins pulling the plane sidewise to the loading platform. Limit switches stop the winch when the plane is within inches of the platform. The baggage conveyor, beneath the plane, whisks luggage to the claim desk as fast as attendants unload it.

Passengers step from the plane onto the sheltered loading platform, walk down a short flight of steps and into the terminal building. Their bags are awaiting them.

The conveyor's direction is reversed and bags of boarding passengers are sent out to the plane. When the plane is loaded, the winch pulls it back out on the airfield—about 90 ft from the dock. The pilot then begins warming the engines for takeoff.

The installation consists of four motors—a 20-hp winch motor, and three explosion-proof, 5-hp motors for the conveyor. The big motor can pull a 75-ton craft 90 ft in 40 sec for less than 1½¢. The small motors move the baggage conveyor belt 150 ft per min.

Three-phase, 208-v, 60-cps power feeds a control panel from a main switch. Four pushbutton stations are provided: one at the upper platform level, one at main dock level, and one for each of two operations on the ramp. Buttons in the dock area are for "inching" the plane the last few feet while docking it.

By means of the ramp control buttons, the plane is carried 150 ft per min until it is 6 ft from the dock. Then it moves under control of "inching" buttons at 30 ft per min. Limit switches stop the plane at the dock.

All controls require an operator on two sets of pushbuttons. Either person, by releasing his button, can stop the operation.

S. H. Hammond, chairman of the board of Whiting, said consideration is being given to extending this system to include fueling and other servicing operations.

Electric Conveyor Expands Warehouse Storage Space

J. M. JENNINGS, Jr., Industrial Representative, New Orleans Public Service Inc, New Orleans, La.

A portable conveyor used by Delta-Wonder Rice Mills, Inc, helps workmen stack 100-lb sacks of rice almost twice as high as a fork-lift truck can reach. The machine nearly doubles the effective capacity of the warehouse, cutting handling and storage costs as well.

The device essentially is an inclined, adjustable conveyor powered from handy 3-phase outlets by a 2-hp, 220-v motor. It is easily positioned by a man who loads sacks on the lower end. Another man at the top unloads the conveyor and stacks the bags. A third man delivers rice to the machine on a hand-truck.

PORTABLE CONVEYOR lifts rice sacks nearly to the roof of this warehouse, increasing storage capacity and cutting handling costs

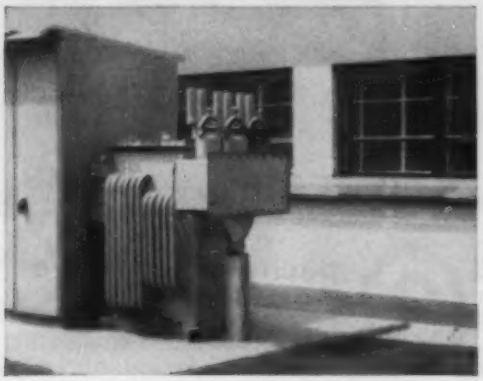
Previously, a fork-lift truck carried and stacked the rice sacks. But it could reach only 15 ft high and required a wide aisle.

PICK UP THAT LOAD

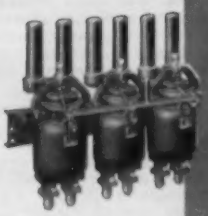
Protect your feeder with G&W type "FC" oil fuse cutouts

Combination Fuse-Switch—heavy all steel housing

provides safety to men and equipment



TYPE "FC" OIL FUSE CUTOUTS
2500—5000—8000 VOLTS TO GROUND



All steel enclosure, hermetically sealed—oil filled, protects men and equipment by safely withstanding high pressures of high voltage fuse clearing a heavy short circuit. In addition to the main purpose—a pressure tight enclosed fuse—the device serves as a full load break oil switch, three phase with gang-operated mechanism. Switching contacts are Beryllium copper. Fuse links are simple, inexpensive and easily replaced. Cable entrances are interchangeable—wiping sleeve, stuffing box or plain porcelain. Type "FC" cutouts are arranged for mounting on connection boxes, on steel structures or walls.

Write us or our representative for latest "CA" bulletin for further data

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Save time testing watthour meters with the

KNOPP

Meter-Testing Equipment, Type TE-7

Power companies the nation over, save time, save money, and build customer goodwill when testing watthour meters with the Knopp Meter-Testing Equipment.

Its new, more-convenient switching arrangement for connecting meter elements permits 2-element and 3-element polyphase meter testing without changing connections. Has Knopp Unload System enabling testing of both elements of a 3-wire, single-phase meter simultaneously without opening the potential link.* Basic constant of rotating standard adjustable to match basic constant of meter-under-test.* Includes photoelectric counter and other time-saving features for accurate testing.

Tests all types of watthour meters. Provides voltage ranges of 120, 240, and 480; current ranges of .25, .5, 1, 1.5, 2.5, 5, 10, 15, 25, and 50. Overall equipment accuracy within .05%.

*Patents Pending

For Fast Field-Test of Watthour Meters, use the Knopp Unload Test Set, Type FS-5, up to 50 amps. Type FS-4 tests meters of 5 and 15 amps. Easy to use, rugged, reliable.

The Knopp Phase Sequence Indicator — for 3-phase 3 wire and 3-phase 4 wire; 60 volts to 600 volts. Rotating Indicator shows sequence A-B-C or C-B-A. Lightweight, compact. Big timesaver.

Also: **Knopp Precision Transformers; Knopp Unload Equipment for testing instruments and instrument transformers.**

For complete technical descriptions please write us today

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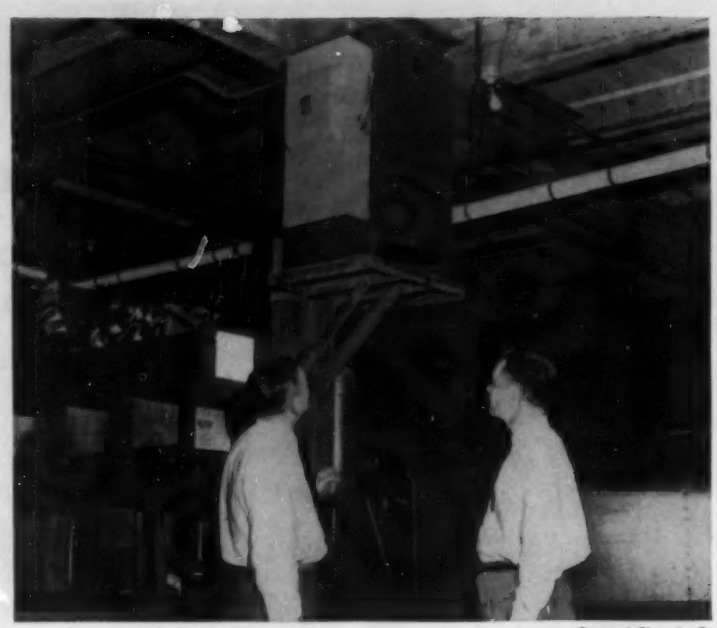


General Electric Co

Capacitors Cut Power Costs $300

Power factor correction from 84% to better than 95% by installation of 450 kvar, saved approximately $300 monthly in power costs and eliminated need for rewiring and some additional electrical equipment at the Colson Corp, Elyria, Ohio. Photo shows capacitor group in the company's truck shop. Other groups are located near the center of load in the screw machine rooms, boiler room, arc welding department and wood shop.

Capacitor-Corrected PF Obviates Plant Shutdown

Correcting power factor with 90 kvar in capacitors at the Bar Mill operation of the Merritt-Chapman & Scott Corp, Milton, Pa, has eliminated the need for an expensive transformer change which would have caused a plant shut down and considerable capital investment. This operation is supplied through a 2,000-kva, 66-kv-2.3/4.0-kv, Wye, 3-phase transformer which is fully loaded.

In order to speed up the rolling process, the company installed a 400-hp, 2,200-v, 3-phase, 60-cycle, slip ring motor and rolls ahead of the roughing rolls which are operated by a 1,200 hp motor. While the operation of this 400-hp motor will not increase the load by 400 hp, (since it will relieve the 1,200-hp motor of some of its load and a diversity will exist between them), it will increase the load on the 2,000-kva transformer and probably decrease the power factor of the Bar Mill operation, if installed without corrective equipment. Thus it was found advantageous to install as much capacity as possible on the terminals of the 400-hp motor. This capacity thus will be switched on and off with the motor. Charlie Warrington, Industrial Power Representative, Pennsylvania Power & Light Co, Williamsport, Pa.

Infrared Halts Cracking

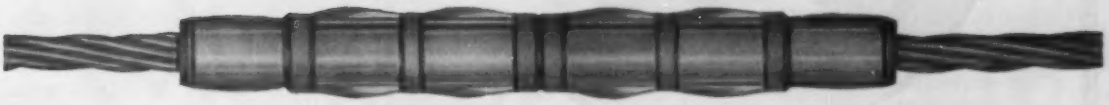
Infrared heating of plastic screw driver handles has completely eliminated cracking when shanks are pressed into them at Kedman Co., Salt Lake City, Utah. Unless the plastic is slightly pliable, the metal shanks will crack the handles when wedged into place. Several 250-w infrared lamps provide the preheat necessary to soften the handles and prevent this. Wayne F. Mulcock, Consultant, Business Development Dept, Utah Power & Light Co, Salt Lake City, Utah.

Nicopress

SPLICING SLEEVES

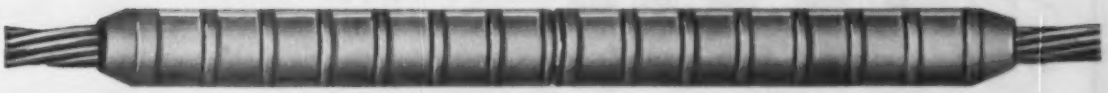
FOR LARGE CONDUCTORS AND HIGH-STRENGTH STRANDS

**Light in weight—Holds full strength of conductor—
High in conductivity**



Completed NICOPRESS Splice on 3/0 Copper Conductor

**Completed NICOPRESS Splice on 3/8" Extra High Strength
Copperweld Strand**



**Completed NICOPRESS Splice on 3/8" Extra High Strength
Galvanized Steel Strand**

Nicopress Sleeves and Tools Patented in U. S. and Foreign Countries. "Nicopress" Registered in U. S. and Foreign Countries.

THE NATIONAL TELEPHONE SUPPLY COMPANY

The National Telephone Supply Company

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The Emblem of Safety

SAFETY LIVE LINE TOOLS

are designed for work at safe distances from energized lines.

Write for Catalog # 8

SAFETY LIVE LINE TOOL CO.

973 - 86TH AVE. • OAKLAND 21, CALIF.

Est. 1926 by Chester C. Coon

INDUSTRIAL BRIEFS

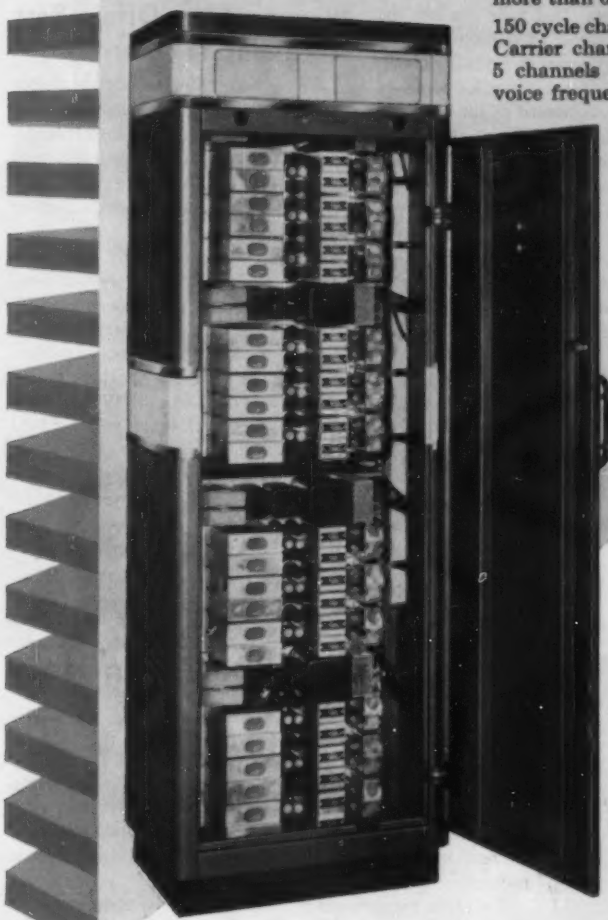
All-electric cooking in new cafeteria at Bethlehem Steel Co, Bethlehem, Pa, has solved the problem of keeping food warm until mealtime. All food is pre-cooked in company's main kitchen and transported to the building housing new cafeteria. A commercial electric range, bun warmers, toasters and steam tables (total load 30 kw) were installed. The range will also be utilized when special orders are required to serve top management and supervisory forces. Final decision to go all-electric was based on advantages of low operating cost, cleanliness and safety. Bill Zboyousky, Industrial Power Representative, Pennsylvania Power & Light Co, Bethlehem, Pa.

Immersion heaters and heating cable maintain corn syrup at low viscosity at Nalley's Inc., Tacoma, Wash. Five 5-kw heaters are situated in the pipe manifold of the hot water system that holds storage tanks at 110F. Hot water is supplied from the central boiler during working hours only. Heating cable of the lead-covered, soil-heating type is wrapped under insulation around all syrup-containing lines. The heating cable is thermostatically controlled by several units to maintain a constant line temperature of 110 F. This prevents the syrup from becoming thick and hard to pump. A. J. Brenninger, Commercial Sales Assistant, Tacoma City Light, Tacoma, Wash.

Keeping tire dies warm at Dayton Rubber Co, Dayton, Ohio, formerly was a problem. The dies must be warmed before they are placed in the tuber head to prevent the rubber from sticking. A Steel table was designed using strip heaters. The dies are 36 in. long, 4 in. high and ½ in. thick. One die is kept on the warming table at all times. The die is heated to 160F. To maintain table and die at this temperature, 3 kw of electric strip heaters were installed. Two thermostats were connected in parallel for operating safety. The dies are now always warm and ready for use. There is little radiated heat to bother the operating personnel. E. W. Miller, Power Sales Engineer Dayton Power & Light Co, Dayton, Ohio.

The right multiplexing is vitally important!

FM Voice Frequency Carrier for simultaneous multiplexing of 18 sub-audio signals over any normal voice channel.



Superior Selectivity & Close Channel Spacing with more than 65 db rejection of entire adjacent channel.

150 cycle channel spacing, allowing up to 18 Voice Frequency Carrier channels on 1 normal voice channel or voice plus 5 channels of VFC utilizing non-critical upper portion of voice frequency spectrum (2400-3200 cycles).

Frequency Shift Design integrated for easy, economical application over power line carrier, microwave, radio or wire line.

Frequency shift in contrast to keyed carrier provides higher reliability and greater security through use of: (1) continuous signal which gives greater immunity to interference and permits constant channel supervision; (2) operation over wider range of changing input signal levels; (3) operation under adverse signal to noise conditions.

Versatility

Motorola Voice Frequency Carrier is designed for every multiplexing requirement, such as:

TELEMETERING OF ALL TYPES
Variable frequency or impulse keyed
TELEPRINTING
SINGLE CHANNEL LOAD CONTROL
ALARMS
INDICATIONS AND REMOTE CONTROL
TRANSFERRED TRIP PROTECTIVE RELAYING

Proven Dependability

Years of successful operation in installations for Power, Water and Gas Utilities, Petroleum and Gas Transmission, and the Government—sending all types of signals over every communication medium.

Write for technical bulletin E-112

voice frequency carrier

MOTOROLA Communications & Electronics, Inc.
Power Utility Products
4501 Augusta Blvd., Chicago 51, Ill.

Motorola

COMMUNICATION SPECIALISTS TO THE POWER UTILITY INDUSTRY

Show 'Em to Sell 'Em

Portland citizens vote $10 million for better street light system after "Operation Night Light" shows them what it will do

Do demonstrations and publicity programs sell street lighting?

Portland, Ore. citizens, after just such a campaign last fall, voted almost two to one to spend $10 million to improve the lights on their streets. In contrast, they defeated by the same margin a $2 million public building proposal.

Much of the credit for the lighting program's victory is being given to "Operation Night Light," a "before and after" demonstration staged only two weeks before the elections.

New mercury-vapor and fluorescent lamps, installed along 12 blocks of a major Portland thoroughfare, were turned on amid the fanfare of bands and a parade. The once-gloomy street was bathed in light. Newspapers followed up with before and after pictures and stories. Radio disk jockeys plugged the event, tying it in with night time driving safety. Ten-sec announcements were run on television. Some 30,000 pamphlets were distributed. Members of Portland's Junior Chamber of Commerce used the demonstration as a talking point in speeches before some 300 groups.

When the polls closed on election day, 90,494 citizens had voted yes for the lighting proposal against 52,500 who voted no. This gave the city the go-ahead to spend $1 million annually in the next 10 years to replace present incandescent lamps along 1,140 mi of streets—streets labeled by the National Safety Council as among the worst lighted in the nation. Property owners will be levied 1½ mills with cost of the program figuring about 1 cent per day per owner.

Entire program was sparked by the Junior Chamber and an east Portland civic group with help from the Electric Club of Oregon and the Illuminating Engineering Society.

Equipment for the lighting demonstration was installed by Portland General Electric Co crews. It consisted of six blocks of fluorescent lamps and six of mercury-vapor. The fluorescents (20 of them at a cost of $8,000) have four 6-ft tubes per fixture mounted 29-29½ ft from the pavement. The mercury-vapors (19 units at a cost of $11,000) are mounted at 30 ft. Both types are 20,000 lumens. They were planned for an average ft-c power of 1.4 for mercury lights and 1.0 for the fluorescents. While a number of new steel poles were erected, many of the lamps were mounted on existing poles. The city paid for the installation.

Wire on Time Offers Best AW Solution—Barrett

Wiring finance plans offer probably the best way to bring America's old house wiring up to the standards demanded by today's electrical living says L. E. Barrett, plan committee chairman, National Adequate Wiring Bureau.

Chairman Barrett, along with Don E. Clayton, president, National Electrical Contractors Association and Albert F. Metz, president, National Electrical Manufacturers Association, will headline the roster of speakers to appear at the 11th Annual Wiring Conference. The conference will be held Feb. 24-25 in Chicago at LaSalle hotel. Registration is open to all elements of the electrical industry concerned with adequate wiring.

(*More Sales & Service on page* 116)

Hay Conveyed for 2¢ An Hour

CARL VAN HARDENBERG, Rural Representative, Washington Water Power Co, Davenport, Wash.

Hay is raised and carried 125 ft for only 2¢ per hr on the farm of F. B. Snook, Chewelah, Wash. The hay conveyor was designed and built by Snook from two conveyor frames, iron parts, two gear reducers, and two electric motors.

Two iron pieces from the conveyor frame were extended to form a table. Arms on the conveyor come around to catch a hay bale and lift it vertically. Next the bale falls onto a 100-ft conveyor which runs it into the barn. There it tumbles off for easy stacking.

The vertical conveyor is run through a 29:1 gear reducer by a ¾-hp motor. Power for the horizontal unit is supplied through an old automobile transmission by a 1-hp motor. Consumption of the conveyor is estimated at 350 to 500 kwhr annually.

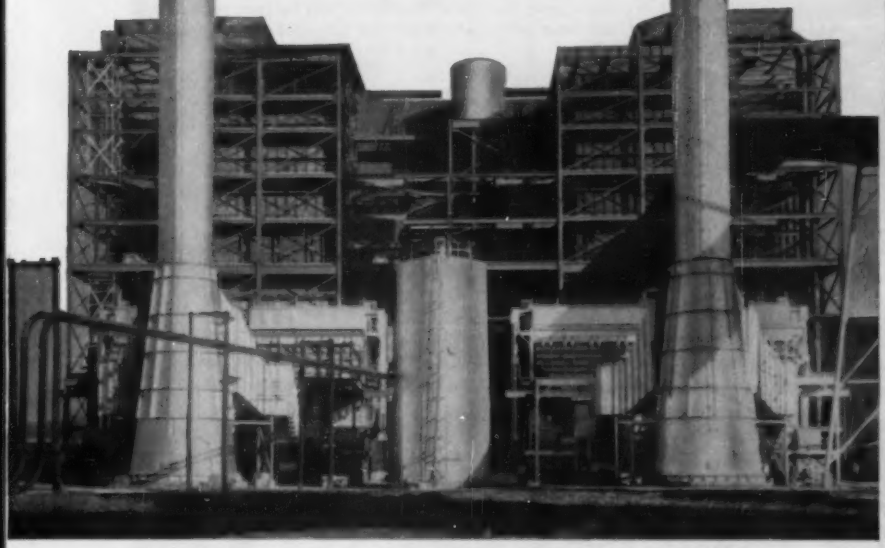
BALED HAY is raised 25 ft and carried 100 ft on two conveyors into F. B. Snook's barn. Power is supplied by ¾-hp and 1-hp motors

What are they using at Meramec?

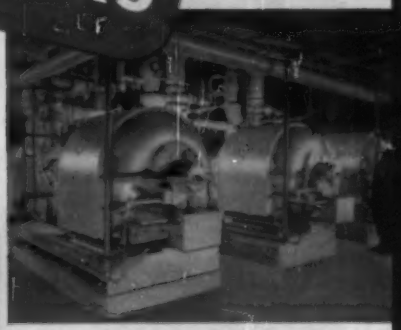
Another utility uses Allis-Chalmers motors. At Union Electric Company's new Meramec plant, all motors for all auxiliaries were furnished by Allis-Chalmers.

Allis-Chalmers builds a complete line of integral horsepower motors for power plant service. Your A-C representative will be glad to help you select the best motors to meet your needs.

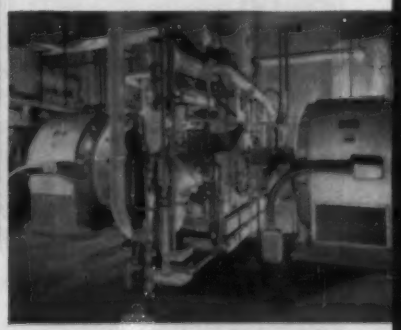
ALLIS-CHALMERS
Auxiliary-Drive
MOTORS



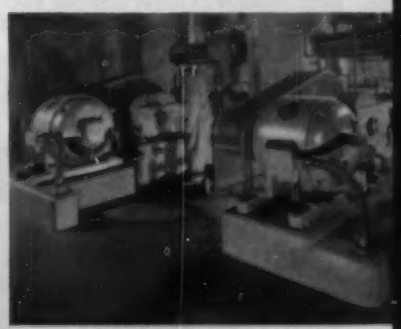
Built in the modern semi-outdoor style, Union Electric Company's Meramec station has two units with a total installed capacity of 250,000 kw.



Three of six 1500-hp, 3580-rpm, 4000-volt Allis-Chalmers two-pole motors driving boiler feed pumps.



Two of three 300-hp, 353-rpm, 4000-volt Allis-Chalmers squirrel-cage motors driving soot blower air compressors.



These compressors provide air for service lines . . . are driven by Allis-Chalmers 100-hp, 1170-rpm, 440-volt cage motors.

ALLIS-CHALMERS

Milwaukee 1, Wisconsin

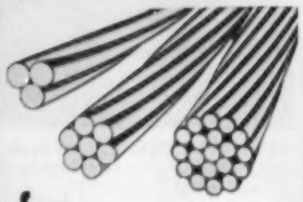
Each induced draft fan is powered by an Allis-Chalmers 1000-hp, 710-rpm, 4000-volt tube-type TEFC motor.

Four of these 500-hp, 425-rpm, 4000-volt vertical pipe-ventilated motors drive condenser circulating pumps.

A-4526

ACCO Quality

PAGE Stainless Steel Strand



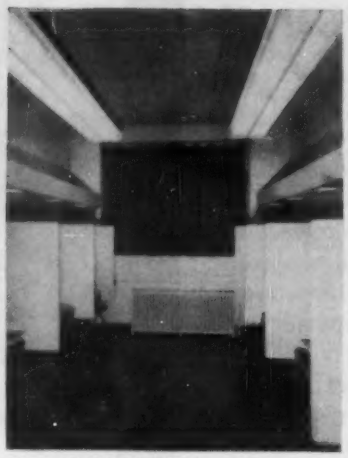
for Severe Service Conditions

PAGE Stainless Steel Strand is equally versatile for ground, guy and catenary applications. Its higher tensile strength, corrosion-and-abrasion resistance, elastic limit and strength-to-weight ratio make it your first choice! And—its lower cost per year of use means long-range economy.

ACCO Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Bridgeport, Conn.

PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE

for Better Value



HIGH ILLUMINATION for visual tests of food is provided by two 8-ft, four-lamp units

LOW ILLUMINATION for taste tests permits written work but is directed away from samples

High to Low Lighting: This Does It

Extreme high to low lighting levels are required in testing foods at General Mills in Minneapolis. Taste tests need low-level illumination to eliminate visual analysis. Visual tests require a high level to allow the taster maximum efficiency.

To get the two conditions, two types of light sources are provided. For the taste tests, lighting is provided by a concentrating-type, recessed, incandescent lens unit with a 60-w clear lamp controlled by a variac. The variac is operated to reduce illumination to 0.01 foot lambert. Lens unit directs the light on the area where the tester makes his written report, while the spill light provides minimum illumination on the food samples to be tasted.

For visual tests, lighting is provided by two, 8-ft four-lamp slimline low-brightness lens units. Units are equipped with prismatic lenses having intensive distribution but also providing good brightness control. Lighting intensity provided here is 200 ft-c. For greater flexibility, two lamps of each fixture are switched independently.

Lighting engineer was Harry W. Spell, Northern States Power Co.

Street Lights to Go Up In Unincorporated Area

Wondering how to sell street lighting in unincorporated areas?

Salt River Power District has done it in a unique contract just approved by customers it serves in an area south of Phoenix, Ariz.

It provides for the Power District to install and maintain about 108, 20,000-lumen mercury-vapor lamps along the main street. Residential customers on the street each will pay 45¢ per month for the service and commercial customers $2.10. Payments are calculated to cover all operating costs and provide a return on the investment within about 20 yr. Each year the district will recompute monthly charges for the following year, taking into account both delinquent and new customers. It expects the rate to decrease, but no annual increase may exceed the original rate by more than 10%. Finally, the district may cancel the service after one year upon 60 days' public notice.

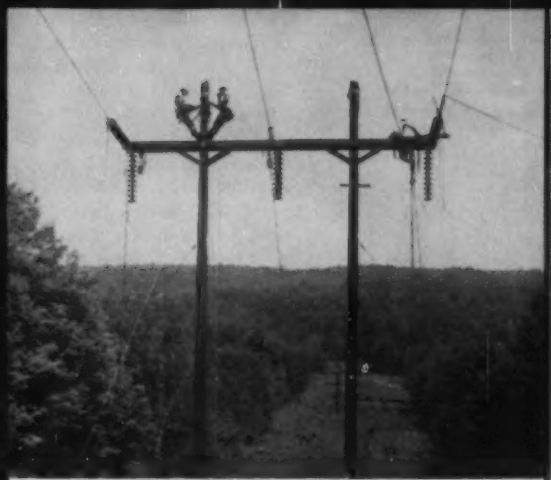
The new lighting system is to be completed sometime next March. A local men's club sponsored the plan and circulated the petition after interest lagged in a previous attempt to set up an improvement district. The contract, believed to be the first of its kind is in effect an agreement with each individual customer rather than with a chartered body.

Installation will begin after negotiations for joint use of telephone poles along the street are completed.

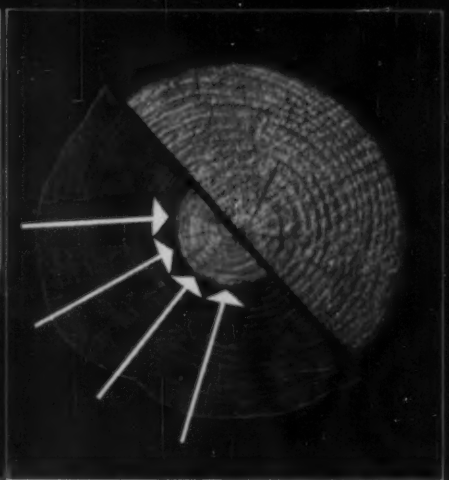
(*S & S Shorts on page* 118)

Another Monsanto case history

Clean Penta-preserved poles won't stain or bleed



PUBLIC SERVICE CO. OF NEW HAMPSHIRE specifies clean Penta protection for western red cedar poles, Douglas fir crossarms. Since 1951, this company has used Penta-treated wood to resist decay and wood-boring insects. Penta gives wood installations at least 4 times longer life.



PENTA GOES DEEP! Cross-section of two poles—Penta-treated at left, untreated at right—shows depth of Penta penetration. Penta effectiveness is as high after 20 years as it is after one month. Penta provides lasting economy!

PENTA PROTECTS WORKMEN, TOO! Penta stays put, will not bleed or leach out of wood. Penta-treated wood is clean, does not "burn" hands or stain clothing and, when properly treated, it is odorless.

SPECIFY PENTA for POLES, CROSSARMS, TRANSFORMER PLATFORMS, BRACES, CONTROL BOXES, PLANKING. More than 85 treating plants will apply Penta for you. Write us for this list, and for "Poles and Crossarms" booklet. Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Box 478-J, St. Louis 1, Missouri.

MONSANTO
CHEMICALS—PLASTICS

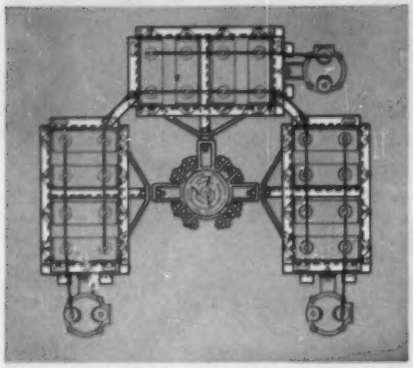
SERVING INDUSTRY WHICH SERVES MANKIND

HANGING CAPACITORS WITH

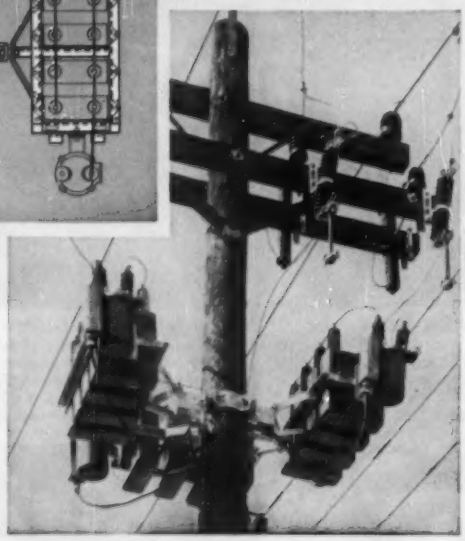
UNIVERSAL CAPACITOR RACKS

SAVES UP TO *40%*

INSTALLATION COSTS



With Universal Racks you simplify hanging capacitors . . . Actual labor time greatly reduced by ground assembly and eliminates gaining the pole—drilling holes — excessive material handling.



NO OTHER HANGING METHOD HAS ALL THESE ADVANTAGES

LOWER COST — per overall installation. Actual records prove saving up to 40% over conventional methods.

NO MAINTENANCE — All parts hot dipped galvanized to most rigid A.S.T.M. specifications. Capacitor racks will outlast pole.

LESS POLE SPACE REQUIRED — Allows multiple units to be installed on one pole. All points on top of—alongside—and under capacitors easily accessible.

BETTER WEIGHT DISTRIBUTION — Prevents buckling and/or drifting of the pole. Stronger installations.

VERSATILE — Will mount either standard distribution size capacitor groups. Universal Pole Brackets will fit any pole from 6 to 10½ inches or 9½ to 14 inches in diameter.

There are other advantages to be found in using Universal Pole Brackets and Universal Capacitor Racks. Write now for free catalogue or request us to send a representative to see you. No obligation, of course.

UNIVERSAL
POLE BRACKET CORP.
P. O. BOX 1118—HOUSTON 1, TEXAS

S & S Shorts

The Sales Picture:

Westinghouse Electric Corp expects this year to be a record in appliance sales with its own sales to increase about 10% over 1953 . . . RCA Victor says it doesn't foresee large mass production of its color TV sets in 1955 . . . Thor Corp predicts sales of home laundry appliance will be up in 1955 and prices will be moderately down . . . 1955 is hailed as a banner year by Allen B. DuMont laboratories after its receiver division, from a unit sales standpoint, turned in its greatest year in 1954 . . . Philco Corp reported in December that it was selling more television sets than ever before in its history . . . ditto Hamilton automatic washers and dryers for 1954's fourth quarter . . . Frigidaire expects industry sales volume of built-in electric ranges to again double in 1955 as it did in '54 . . . December sales of Westinghouse washers and dryers were highest of any month—30% more than in November, 1950, the next highest period.

New Products:

Carrier Corp has introduced packaged air conditioning units, designed for stores and office suites, which require no water. Suitable for places where piping difficulties or water restrictions exist, the units can be had in four sizes from two to 7½ hp.

Superior Electric Co, Bristol, Conn. announces new simplified, low-cost method of controlling the light intensity of rapid start fluorescent lamps. The system consists of a light control used with specially-designed ballasts. Maker says, combination provides excellent performance without the problems of warm-up time and tube replacement inherent in complex electronic control devices.

Shorties . . .

First certification under industrial and commercial relighting promotion program of the National Lighting Bureau was awarded last month to the Fall River, Mass. Police Station . . . Stewart Warner Electric Division is withdrawing from manufacture and sale of radios, TV sets and phonographs within the U. S. to concentrate on development of electronics products for government and commercial, industrial applications.

The data you need easy to find in this Uptegraff

ENGINEERING MANUAL

Designed for quick reference, this manual gives in easy-to-find form, dimensions, performance data and other essential information on Uptegraff Power Transformers of all commercial ratings from 750 to 10,000 KVA. It describes liquid-filled, single and three-phase transformers up to the 67 KV Class. Standard and optional accessories are listed; terminal arrangements, vector relationships and schematic representations are shown.

Copies of this engineering manual will be useful in many ways in executive, engineering and operating departments.

R. E. Uptegraff Manufacturing Co.
Scottdale, Pennsylvania

Send for free copy of this useful Uptegraff Power Transformer ENGINEERING MANUAL. Write on company letterhead or use the coupon below.

R. E. UPTEGRAFF MANUFACTURING CO. (EW)
Scottdale, Pennsylvania

Gentlemen: Please send a free copy of your ENGINEERING MANUAL Bulletin 133 to:

Name _____ Title _____

Company _____

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Looking at 1955

From year-end statements by manufacturers

"The future of the aluminum industry continues to be bright with promise. New markets for this light metal (aluminum) are developing steadily. Established uses are achieving healthy increases. The market outlook for 1955 is good, and long range potentials are also most encouraging."

I. W. Wilson, President
Aluminum Company of America

". . . it is estimated that freeworld nickel production in 1955 should approximate 415,000,000 lb. It is expected . . . more nickel will be available to freeworld industry for civilian applications in 1955 than was the case in 1954."

Dr. John F. Thompson, Chairman of Board of Directors,
The International Nickel Co.

"A most favorable year for the copper and brass mill industry is indicated for 1955. The expansion of public utilities, especially electric power, and the great growth of schools, hospitals and industrial plants will require additional quantities of these metals (copper and brass)."

T. E. Veltfort, Manager
Copper & Brass Research Association

"Outlook for 1955 is encouraging and an improvement of approximately 5% over 1954 is expected."

A. F. Metz, Chairman of Board of Directors
Okonite Co.

". . . we anticipate a volume greater than the general industry level during next year . . ."

N. J. MacDonald, Vice President
Thomas & Betts Co.

". . . industry production of television receivers in 1955 is currently estimated around 6,000,000 sets . . ." ". . . anticipated that 1955 will witness greater utilization of transistors, printed circuitry, and other advanced engineering and production techniques . . ." ". . . estimated that more than 10,000,000 new radio sets . . . will be sold at retail . . ."

David Sarnoff, Chairman of the Board
Radio Corporation of America

"I believe . . . higher power in broadcasting will continue . . . should be at least 530 television stations in operation in United States . . . retail television sales for the year should total about 5,800,000 monochrome sets and 200,000 color sets . . . retail radio sales are estimated at 6,500,000 units for 1955 . . . first quantity production of general purpose transistors will be achieved . . . new designs in germanium rectifiers will nearly quadruple the volume of business in 1954 . . . two-way radio communication in mobile applications will continue to expand with total industry sales approximately 10% higher than 1954 . . ."

W. R. G. Baker, Vice President, Electronics Division,
General Electric Co.

"A continuing increase in air conditioning sales during 1955, spearheaded by gains in home and existing office building installations . . ."

Cloud Wampler, President
Carrier Corporation

Mexico Seeks Border Appliance Market

Mexico City—(MHWN)—Mexican manufacturers of household appliances have for many years conceded the market in such border areas as Lower California and cities adjacent to Texas to American suppliers. It was felt that there was no competing with the Yankees as residents in this area were buying imported goods free of duty.

However, recently 12 carloads of Mexican-made appliances including electric refrigerators, washing machines and stoves were dispatched to Mexicali, capital of the state of Baja California, as a step toward recovering these markets for Mexico.

It is claimed the Mexican-made appliances are as good as those of the United States and cheaper in many cases due to lower labor costs. Firms participating included IEM, the Westinghouse affiliate in Mexico, and the Frigidaire department of General Motors de Mexico.

Weston Museum to Get New $1-Million Home

The Weston Museum at Newark College of Engineering will have a new home in the $1-million building to be erected at High Street and Summit Place, Newark, N. J. The memorial to Dr. Edward Weston, a founder of the college, is now part of the 60-year-old Weston Hall to be replaced by the seven-story building.

Dr. Weston developed in 1888 the first practical electrical measuring instrument, the moving-coil voltmeter, and founded the Weston Electrical Instrument Co which today manufactures more than 850 varieties of precision instruments. In 1936, he willed to the college the museum which contains the first Weston dynamo and a display of regulators, rheostats, circuit breakers, station ammeters, direct-reading voltmeters, and lamps, all bearing the Weston patent.

The bequest included Dr. Weston's personal collection of 15,000 volumes, then one of the country's largest private scientific libraries.

(*More M & M on page* 133)

Solving load problems as more homes "go electric"

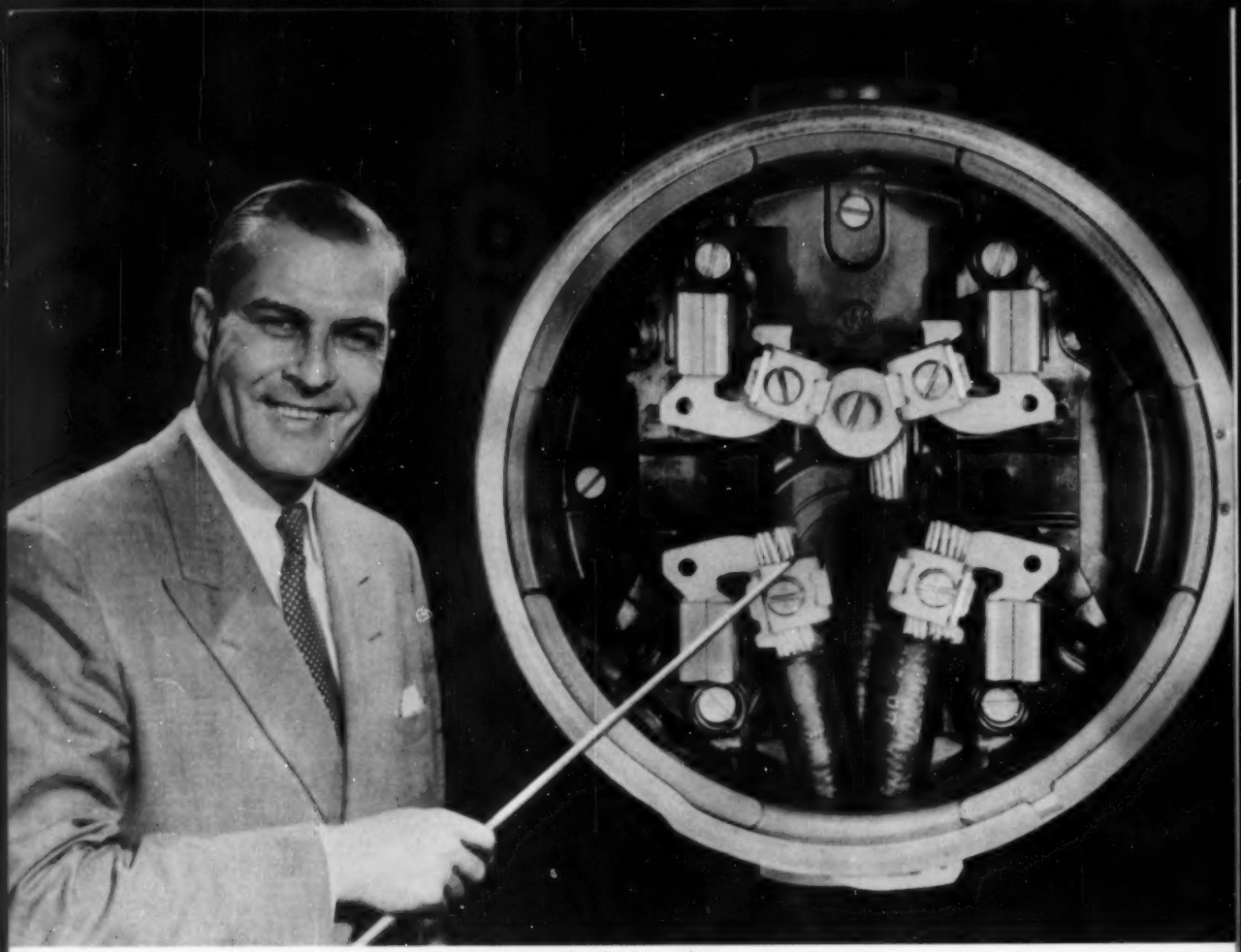
The past decade has seen utilities match the nation's tremendous housing expansion with corresponding system growth.

As more homes "go electric," the future points to increasing loads on these lines. On the following eleven pages, Mr. F. D. "Whitey" Hurd, Westinghouse Consulting and Application Engineer, and product experts discuss some specific ways you can meet this trend—on a practical basis.

On the next page, the Meter Division leads off with news about the new meter socket . . .

YOU CAN BE **SURE**...IF IT'S

Westinghouse



Note how the bus-type terminals easily accommodate heavy conductors. Terminals swivel in an arc, thus reducing wire bending to a minimum.

New meter socket wires easily with up to #0 conductors

Heavy conductors up to #0 are no problem with the new Westinghouse die-cast aluminum meter socket. Wiring is simplified because of the new bus-type terminals. These terminals swivel for easy alignment with the conductors. On installations using heavy conductors, the tops of the terminals may be removed, conductors simply dropped into place, and the tops replaced. Smaller wires may be inserted into the terminals without removing the tops.

The socket has outside hubs to give more room inside for wiring. Terminals have large contact surfaces with "follow" action, insuring a solid connection on aluminum or copper conductors. All sockets have a breakout in the back for use when three-point mounting is required.

A new sealing ring which can be installed without tools is supplied with this socket. Since the socket, ring and meter rim are all iridited-aluminum, no electrolytic corrosion can take place.

The socket is available for either single or polyphase service with two or three outlets, in 1-inch, 1¼-inch and 1½-inch hub sizes. For more information, write for booklet B-6377, which contains the complete story about this socket.

YOU CAN BE **SURE**...IF IT'S

New secondary capacitors: 40% lighter, easier to handle

As they "power up" for modern living, America's homeowners are buying over a million air conditioning units a year. That looks good on load growth charts—but what about power factor?

The new Westinghouse 3 and 5-kvar secondary capacitors are the answer. They're inexpensive, light, easy to handle and completely flexible. They'll enable you to boost power factor on heavily loaded secondaries *at lower cost per kilovar than ever before.*

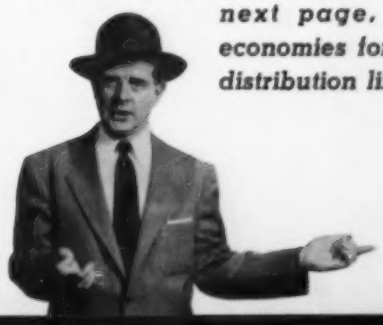
These new secondary capacitors offer you an exclusive cost-reducing design feature: tubular cases of 16-gauge extruded aluminum. They weigh only 16 and 25 pounds respectively—*40% less than comparable units.* A lineman can carry them up a pole and install them in a matter of minutes. They will never corrode —never need painting.

These capacitors can be mounted with bushings up or down—bolted directly to the pole or mounted on the crossarm with a standard EEI-NEMA bracket. Leads are furnished and, when required, external bushing-mounted indicating fuses can be supplied.

The use of secondary capacitors can be readily justified. You can prove this for your system by following the simple procedure outlined in a technical paper, *Application of Secondary Capacitors on Overhead Systems* by Hamilton Brooks. Write for it today.

Hamilton Brooks, Supervisory Engineer, Capacitor Section, with the new 3 and 5-kvar capacitors. Designed for use with 7½ and 15-kva transformers, the capacitors usually are placed about two-thirds of the distance from the transformer to the end of the line.

Austin Fink of the Switchgear Distribution Apparatus Department points out, on the next page, important economies for residential distribution lines.



Westinghouse

Austin Fink, Manager of Recloser, Cutout and Fuse Engineering, shows the standard 5.2-kv enclosed cutout box with its seven interchangeable doors.

Enclosed cutout interchangeability reduces distribution costs

One porcelain box—seven interchangeable doors! That's what you get with Westinghouse enclosed fuse cutouts—and it means a lot to you in the face of rapidly rising residential loads.

It means you don't have to change the entire cutout when fault or load current exceeds the rating of your present standard cutout. All you have to do is replace the door. It saves labor out on the line. Reduces inventory, too—for change of ratings, only the doors need to be stocked, not the boxes.

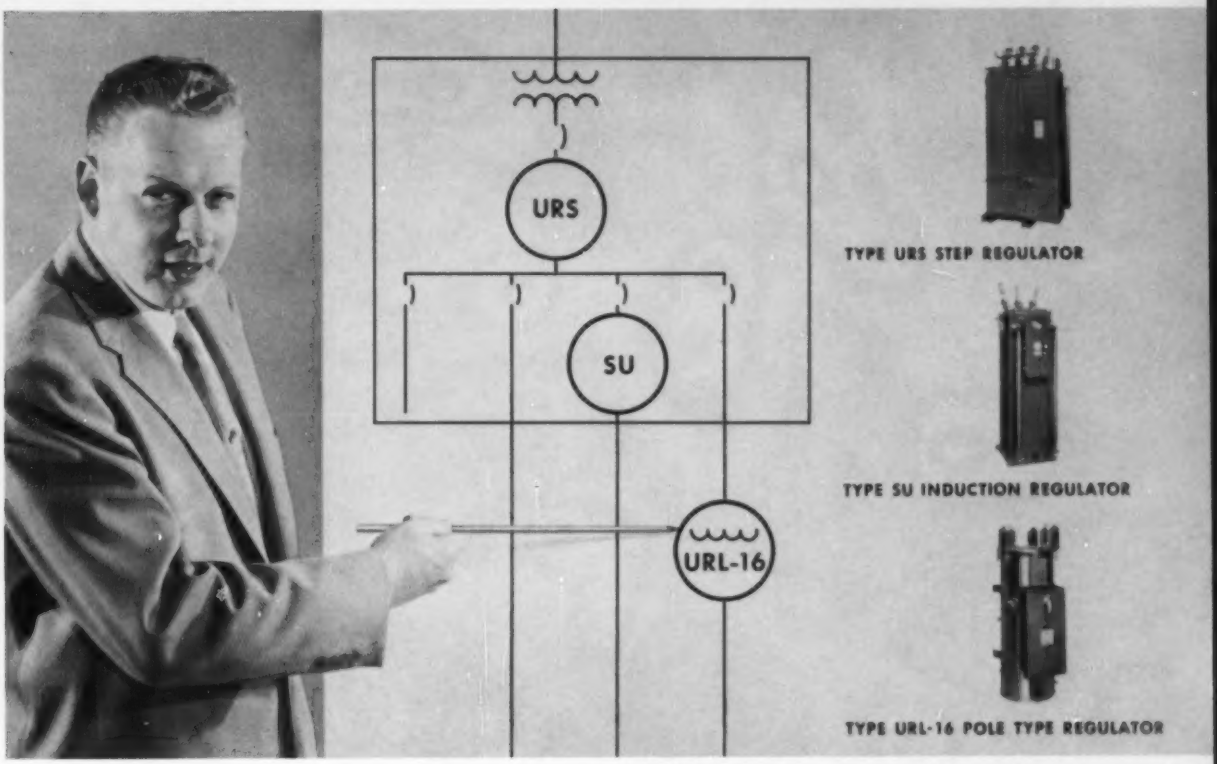
For 5.2-kv service, there are three ratings for one box: EA-50, the standard 50-amp, 1200-amp I.C. cutout . . . HC-50, a high-capacity 50-amp, 5000-8000 amp I.C. cutout . . . MC-100, a new 100-amp, 5000-8000 amp I.C. cutout. These three ratings are available in both dropout and non-dropout types. And there's a 100-amp disconnect blade. *Seven interchangeable doors—one porcelain box.* Equivalent number of ratings available for 7.8-kv service.

You can count on these additional benefits with Westinghouse enclosed cutouts: Exclusive Prestite® porcelain process insures proper fit of doors. Fewer joints in the current path mean less heating, less corrosion and longer life. On dropouts, the door swings through 180° for greater visibility and safety.

Complete facts are in DB 38-610. Write for it.

YOU CAN BE **SURE**...IF IT'S

On the line or in the substation . . . these regulators cut costs, improve service



Al Cleveland, Regulator Sales Engineer, with a single line diagram showing regulator applications.

The complete line of Westinghouse regulators makes it possible for you to apply either step or induction types to meet specific requirements throughout your distribution system.

Very important in meeting growing loads is the URL-16—pole-type step regulator. This advanced 16-step regulator with its exclusive "inverse integrating" voltage regulating relay assures you *the closest effective bandwidth possible in any step-type regulator.* And it does it with fewer operations and simpler construction—for long contact life and minimum maintenance.

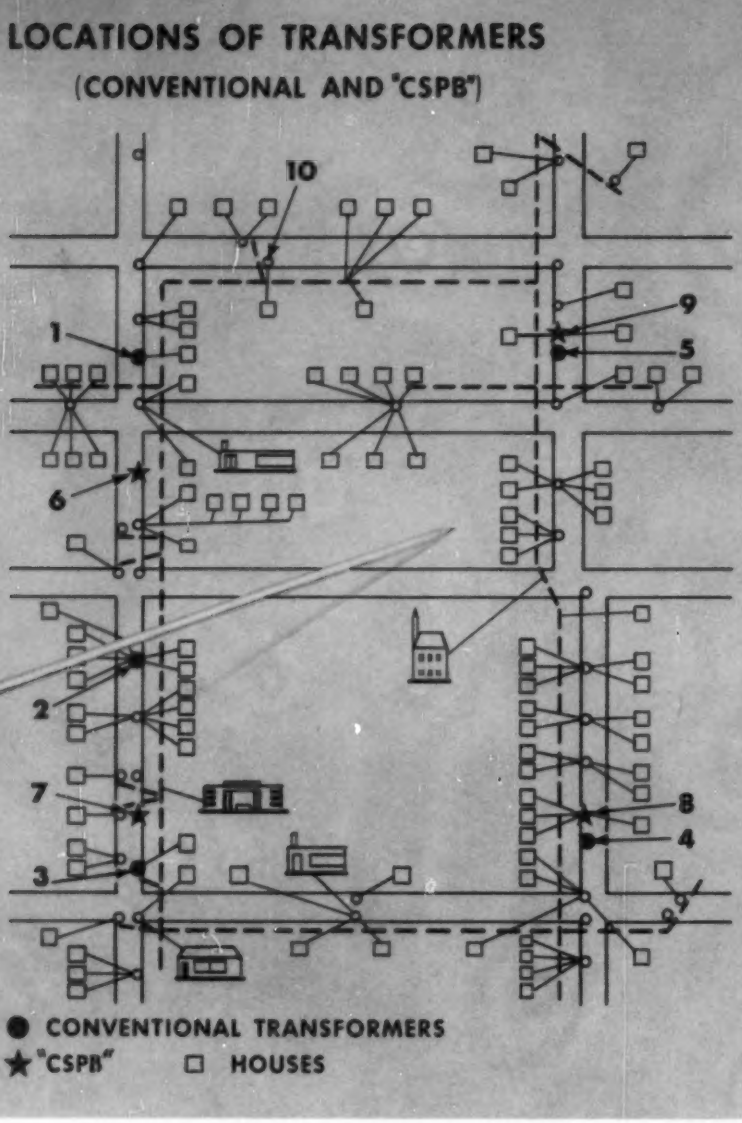
For station regulation, the SU induction regulator has proved its superiority with pin-point accuracy and absolutely minimum maintenance. SU "all-electric" control assures Class 1 accuracy and eliminates mechanical control adjustments. Just turn knobs on the convenient control panel.

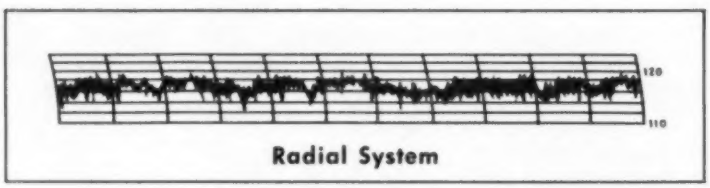
Also for station regulation, the all-new URS is the most accurate, most compact, station-type step regulator you can install. A lifetime Class 1 "all-electric" control and separately compartmented, easily accessible tap-changer contacts are just two of the many features you should investigate if your load problems require the best station regulation.

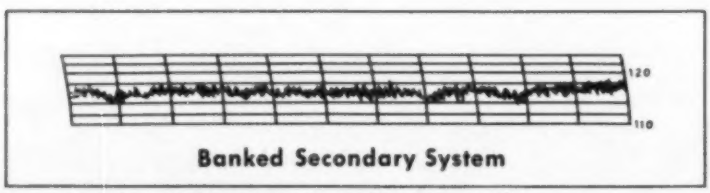
In fact, wherever you want the best regulators, at no extra cost—to meet your specific load requirements—look to the complete Westinghouse line. Booklet B-6053 with complete product details and application data is available from your local Westinghouse representative.

On the next two pages Bob McCollom of the Transformer Division talks about transformers and banked secondaries in residential areas.

Westinghouse







R. N. McCollom, Sales Manager, Transformer Division, points out utility test area with conventional transformers at locations 1, 2, 3, 4 and 5. These were replaced with "CSPB" transformers at 6, 7, 8 and 9. Instantaneous voltage dips at location 10 were recorded before and after "CSPB" transformers were installed. A 45% reduction was achieved.

BY ACTUAL TEST,

"CSPB"® transformers provide for load growth . . . improve regulation at lower cost

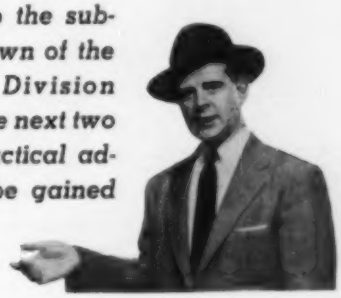
Actual tests conducted on well-defined load areas have proved the inherent superiority of the "CSPB" banked secondary system in handling growing residential loads . . . while improving voltage conditions at less cost.

The test area selected had five conventional transformers totaling 55 kva, serving 106 residential and five commercial customers. A survey of major appliances in use indicated that considerable load growth could be anticipated. Existing load and voltage conditions were recorded over a period of two months.

Following this, the five conventional transformers were replaced by four 15-kva "CSPB" units. Again, load and voltage conditions were recorded over a period of five months. The findings are tabulated in the load data table, below.

The result? Average voltage conditions were improved by 7% . . . with far less capacity than would have been required to make the existing radial system adequate. In addition, all of the benefits of "CSPB" construction were realized. For further information, write for booklet B-4310A which contains complete data for your application.

Moving back to the substation, Roy Brown of the Transformer Division points out, on the next two pages, how practical advantages can be gained there, too.



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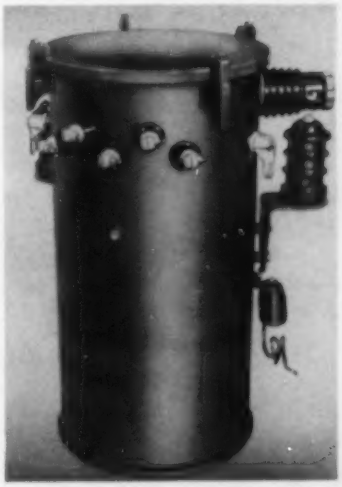
FOR RADIAL SYSTEM

Transformer No.	Kva Rating	Individual Load Peaks Kva	%	Transformer Loads at Time of Peak Load for System Kva	%
1	7½	11.04	147	8.40	112
2	10	12.96	130	11.52	115
3	7½	18.72	249	8.40	112
4	15	18.00	120	14.64	98
5	15	18.00	120	17.28	115
Tot. 5	55	78.72	147	60.24	110

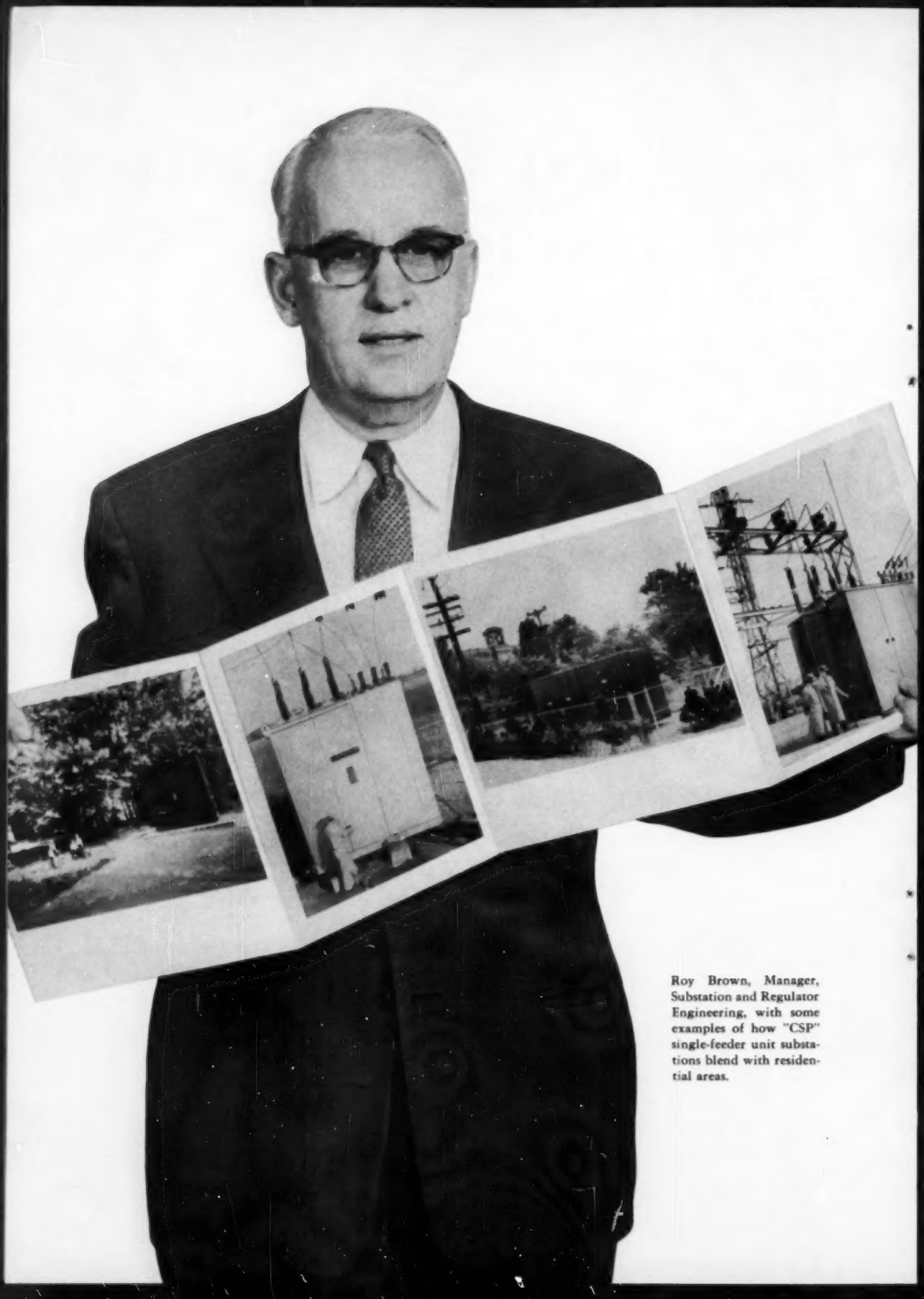
FOR "CSPB" BANKED SECONDARY SYSTEM

Transformer No.	Kva Rating	Individual Load Peaks Kva	%	Transformer Loads at Time of Peak Load for System Kva	%
1	15	17.28	115	14.88	99
2	15	17.76	118	17.28	115
3	15	15.84	105	15.84	108
4	15	15.84	105	14.40	96
Tot. 4	60	66.72	111	62.40	104

Peak load data table shows more uniform load distribution in banked secondary system. Same load growth on radial system would have required much more than the 5 kva added with "CSPB" transformers.



"CSPB" distribution transformer for banked secondary system has built-in lightning, short circuit and overload protection. A system of "CSPB" transformers cannot cascade.



Roy Brown, Manager, Substation and Regulator Engineering, with some examples of how "CSP" single-feeder unit substations blend with residential areas.

Flexible substation . . . makes a good neighbor

For single-feeder substations—in residential areas—the Westinghouse "CSP"® power transformer is a logical choice because of these significant points:

Residential Acceptance — Because the "CSP" power transformer is compact, attractive, quiet and safe, it makes a good residential area "neighbor". You can locate substations to achieve best system efficiency—with less likelihood of objections arising from residential or commercial restrictions.

Factory Coordination—You place a single order and get in one compact unit, a complete single-feeder substation with the 43 components of a conventional substation built in, coordinated and tested at the factory. You eliminate all the time-consuming shipping, expediting and installation coordination necessary with conventional substations.

Simplified Installation—The "CSP" power transformer requires a minimum of real estate . . . and only one foundation. Unload it—tie in transmission and feeder lines and it's ready to go—with complete lightning, surge and fault protection, automatic voltage regulation, load switching and metering. Site-erected substation installation time is reduced 4 to 1. Landscaping is made easy.

When loads are increasing, additional "CSP" power transformers can be easily added. When loads shift, they can be easily and economically moved—with full salvage value. Booklet B-4692 includes still more advantages. Write for it.

On the next two pages Herman Barsun of the Transformer Division discusses substation regulation in relation to your residential load problem.

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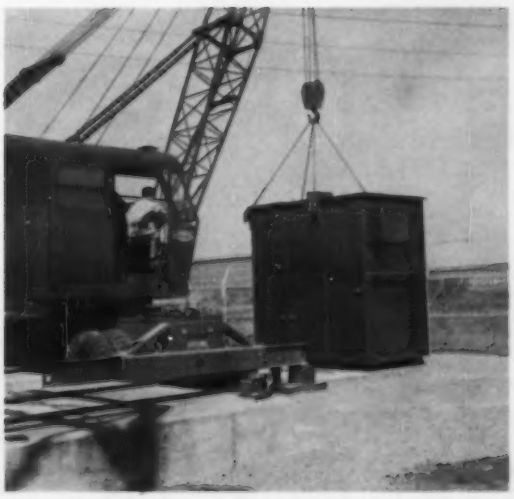


Installing a "CSP" single-feeder substation is a simple process because it is delivered *complete* in one shipment. Unload it—tie in transmission and feeder lines—and it's ready to go.

Herman Barsun, Section Manager, Regulator Section, Transformer Engineering, exhibits the compact orderly construction of the new URS load tap changer.

Consumer satisfaction demands accurate substation regulation

Well-regulated utilization voltage at your customer's service entrance depends on accurate and reliable regulation at the substation level. Whether you are considering "CSP" power transformers, unit substations or standardized power transformers, the URS load tap changer assures you not only accurate and dependable voltage regulation but *quiet* operation as well.

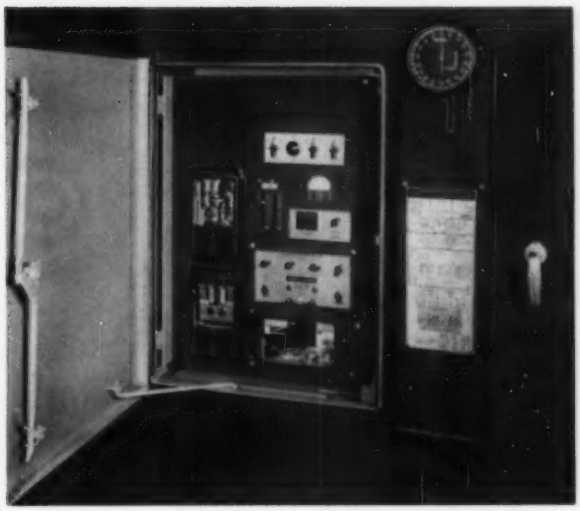
Contributing to both quiet and dependable operation, the Geneva gear drive is the heart of the URS operating mechanism. Contacts move at the optimum speed to prevent burning, yet are accelerated and decelerated smoothly for shockless operation.

You will also appreciate the improved appearance of the new URS housing. The control cabinet is an integral part of the tap changer, resulting in minimum size and weight. All control devices are mounted on a hinged steel panel assuring maximum convenience for operation and maintenance.

The control cabinet contains the new SJS voltage regulating relay. Simple, dial-operated, all-electric settings eliminate mechanical adjustment devices. Hinge-spring construction eliminates pivots and bearings. Factory sealed—not even contact dressing is needed.

Your local Westinghouse representative will be glad to discuss further details of the new URS load tap changer with you.

YOU CAN BE SURE...IF IT'S
Westinghouse



Hinge-mounted for easy accessibility, the integral control panel includes SJS voltage regulating relay, time delay relay, motor control relay, and manual control provisions. Operation and maintenance are simplified.

Complete SJS voltage regulating relay is mounted with four bolts and wired through plug-type connectors for ease of routine testing. All-electric settings eliminate mechanical adjustment devices.

D. N. Reps of Electric Utility Industry Engineering worked out the hypothetical equivalent system that solved this particular problem.

"Equivalent systems" analysis solves feeder-voltage problems

"A medium-sized city in the midwest faced a problem that is becoming increasingly common as more homes 'go electric'.

"It was apparent that the present 2400-volt feeders would soon be overloaded, and the utility was concerned about regulation and outages that could result in loss of goodwill, as well as revenue.

"Together with the utility engineers, we went over the problem in detail, even surveying the area to determine geographical and physical factors. Armed with this information, we took the problem to the Distribution Engineers at East Pittsburgh for solution by the unique method of constructing a hypothetical equivalent system. Thus, comparable voltage levels and substation ratings could be checked, yielding results applicable to the actual system.

"The results of this study clearly showed that optimum economic design could be achieved by changing over to 4160 volts. The utility is now in the process of making the change-over . . . ample proof that they were pleased with the study."

These and many other facilities, backed up with broad Westinghouse experience, are available to you, around the clock. For any generating, transmission or distribution problems you might encounter, resources like these are priceless. CP-1022-A

For additional information or literature on any of the products discussed on the preceding pages, contact your local Westinghouse representative, or write direct to Westinghouse Electric Corporation, 3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pa.

YOU CAN BE **SURE**... IF IT'S **Westinghouse**

Uni-Bus System is a development by Roller Smith Corp. W. A. Kuhar, left, manager of engineering, and R. C. Lipps, vice president, discuss the butt type plug and a safety slide

Roller Smith to Add Uni-Bus Systems

A new development in low-voltage (0-600v) feeder and plug-in bus systems will be introduced soon by Roller Smith Corp, Bethlehem, Pa. This type of bus is to be known as Uni-Bus and will be an addition to the company's line of switchgear and meters.

The bus design incorporates many new features, according to the manufacturer. Some significant features follow. Construction details are identical for both the feeder and the plug-in types of bus. A single size ventilated steel enclosure accommodates current capacities from 225 to 775 amp. A duo-circuit arrangement makes possible low-reactance characteristics for both types of bus. Weight savings are claimed up to 40%. Installations may be either horizontal or vertical. Flexible connectors serve as elbows, offsets and expansion fittings. Uni-Bus plug may be isolated from bus by safety slide on bus housing, and utilization circuit is energized through primary and secondary contacts on the plug.

RABC Bus Conductor Developed by Reynolds

A new electric bus conductor material, known as RABC (Reynolds Aluminum Bus Conductor), is a recent development of Reynolds Metals Co, Louiseville, Ky.

Some outstanding features are:

- Minimum tensile strength is 29,000 psi.
- Conductivity is almost as much as EC aluminum—79% that of copper, compared to 82% for EC-H17 bus conductor.
- Flatwise bending meets requirements of EC bus bar; edgewise bend tests indicate superiority over EC-H17.
- Compressive strength is higher than EC aluminum; thus is provided higher contact pressures and more permanent stresses at joints under repeated heat cycling.
- Any size and shape may be obtained for which the quantity will justify a small die cost.
- Savings are significant on basis of current-carrying capacity and weight.

Reactor Proposed

A nuclear reactor has been proposed as part of the electrical engineering research facilities to be housed in a $1-million laboratory

The Old Reliable

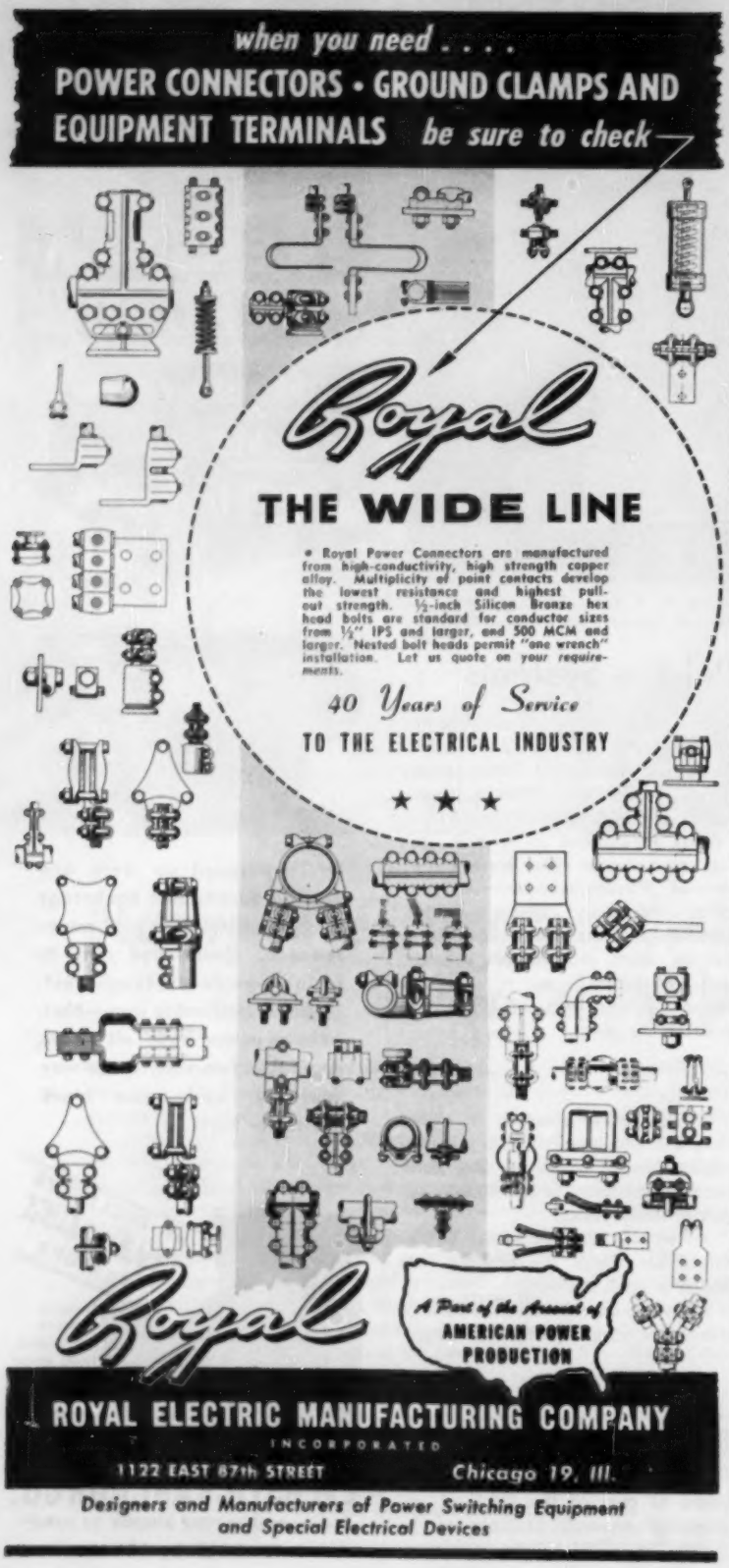
EVERSTICK ANCHORS...

EXTRA Holding Power
QUICKLY Installed
TOUGH For long life

● They speed up work and provide dependable anchorage in new construction and maintenance. Quick and easy to install—made of tough rust-resistant malleable iron—their holding power "tops" all others. Available two-way, three-way, four-way, and cone types. Write for facts.

Exclusive Everstick nut housing. Locks anchor firmly on rod. No chance of rod slipping thru anchor.

EVERSTICK ANCHOR CO.
Manufacturer of "THE ANCHOR OF MERIT"
FAIRFIELD, IOWA


when you need . . . .
POWER CONNECTORS • GROUND CLAMPS AND
EQUIPMENT TERMINALS be sure to check
Royal
THE WIDE LINE
• Royal Power Connectors are manufactured from high-conductivity, high strength copper alloy. Multiplicity of point contacts develop the lowest resistance and highest pull-out strength. ½-inch Silicon Bronze hex head bolts are standard for conductor sizes from ½" IPS and larger, and 500 MCM and larger. Nested bolt heads permit "one wrench" installation. Let us quote on your requirements.
40 Years of Service
TO THE ELECTRICAL INDUSTRY
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Designers and Manufacturers of Power Switching Equipment
and Special Electrical Devices

building. The one-story building, 72 by 216 ft, is to be built on the campus by Armour Research Foundation of Illinois Institute of Technology, Chicago, in 1955, according to Dr. Haldon A. Leedy, director.

MANUFACTURING BRIEFS

NEMA Standards. New publication No. IC-2-1955 on resistance welding control is expected to be available about February 15, 1955; price between $2.50 and $2.75. Automatic revision service will be provided.

Radio Corp of America will install microwave radio relay systems for two utilities. Colorado Central Power Co will have a multi-hop system from Littleton to top of Lookout Mountain and on to Fort Lupton, a distance of 50 miles. In addition a 3-mile line will interconnect at Lookout Mountain to Galden. Southern California Edison Co will have a 5-mile one-hop system to link Barre substation, near Stanton, and Katella substation, near Orange, Calif.

Arvin Industries, Inc, Columbus, Ind, has formed an electronics products division; Leo W. Burns is sales manager . . . **Polorad Electronics Corp,** Brooklyn, N. Y. acquired 55,000 sq ft of floor area in a new plant in Long Island City, N. Y.; engineering and production capacity will be increased 50% . . . Newly formed electronics division of **Seneca Falls Machine Co** will be housed in a new building (completion about April) adjacent to the main plant at Seneca Falls, N. Y.

Farrand Optical Co, New York City, presented to Stevens Institute of Technology, Hoboken, N. J. an electrostatic electron microscope, capable of magnifying an object 100,000 times . . . Basic and applied research laboratories of **Pittsburgh Plate Glass Co** have been opened at Springdale, Pa, for applied paint and plastics research operations.

Sangamo Electric Co has renewed for the fifth consecutive year a contract with Southern Illinois University for capacitor research by physics students. The program is administered by two S.I.U. staff members and two representatives of the utility.

ARE YOUR HANDS TIED...

BECAUSE EXISTING CIRCUITS LACK ADEQUATE CAPACITY TO CARRY THE LOAD

ROCKBESTOS AVC®

(N.E.C. TYPE AVA)

CAN INCREASE CURRENT CAPACITY 30 TO 50%

All you need do to get added capacity without changing present conduit is to rewire present circuits with Rockbestos A.V.C. . . . the wire and cable that size for size carries more current than other types of insulated wire.

Phone or write the nearest Rockbestos branch office and one of our wire specialists will analyze your particular requirements.

STOCKED COAST TO COAST

Standard Rockbestos A.V.C. (N.E.C. types AVA, AVB, etc.) are available from stock for immediate shipment. Call or write nearest branch office.

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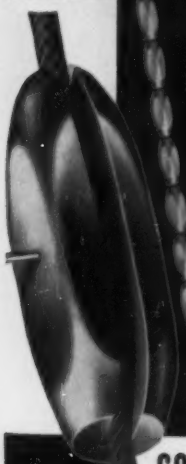
Eliminate
GUY GUARD TROUBLES
this easy
Flexibal
way



1 SLIP OVER WIRE
2 DRIVE HOME NAIL
3 ATTACH CLAMP
"the Economical Guard that can't go wrong"

R.E.A. APPROVED
COSTS 1/3 LESS THAN METAL GUARDS
AND
NO MAINTENANCE PROBLEM

FLEXIBAL Guy Guards provide the flexibility that yields with the blow and cushions the impact. Aluminum-painted, they increase the day and night visibility. Easiest guard to handle, simplest and quickest to install—by all odds safest in use, with a proven record of greatly reduced losses. Specify it for better appearance, greater convenience, and major savings.

Used and Praised by Constantly Growing List of Utilities
Write for Free Sample and Prices

IMMEDIATE DELIVERY
TEN COMPLETE SETS IN THIS ONE LIGHT EASY TO HANDLE CARTON

SEE YOUR JOBBER OR WRITE TO
S. E. OVERTON COMPANY
SOUTH HAVEN, MICHIGAN

SALES ASSIGNMENTS

COMPANY STAFFS

Elliott Co, Jeannette, Pa., has named O. M. Sievert as its Kansas City district manager. Sievert, who joined the company in 1944, has served as assistant district manager in the Kansas City office since July, 1953.

Bailey Meter Co, Cleveland, has appointed two managers for its newly established district offices in Dallas, Tex., and Memphis, Tenn. F. D. Krusemark is manager of the Dallas office located at 6331 Aberdeen Ave. The Dallas district covers the territory of northern Texas and northwestern Louisiana. The Memphis office, located at 3256 Hendricks Ave., is under the managership of R. E. Byers. This district includes western Tennessee, northern Mississippi, and the state of Arkansas.

Hubbard & Co, Pittsburgh, has promoted John E. Wennogle from New England district manager to division sales manager for the New York area, covering New York and New England and parts of New Jersey. His headquarters will be at the firm's New York office. Wennogle's former territory of New England, which is still under his supervision, will be taken over by John J. McQueeney, formerly with General Electric Co and Appleton Electric Co. McQueeney's territory covers all of New England except Connecticut. He will be headquartered in Boston.

General Electric Co's Carboloy Department has named Max E. Hartl manager of magnetic materials sales with headquarters in Detroit. Hartl, formerly Atlantic district magnetic materials representative, replaces E. L. Hubbard, who has been assigned to develop magnet sales on the West Coast. Hubbard will make his new headquarters in Los Angeles. Both assumed their new duties Jan. 1. In the shift, W. S. Gripman from the Detroit office will take over Hartl's position in the Atlantic district, and J. C. Betts will be transferred from Detroit to the East Central district office in Cleveland.

Allis-Chalmers Manufacturing Co has named Norman L. Danforth as manager of the General Machinery Division's Toledo district. Danforth, a representative in A-C's Philadelphia district office since 1947, succeeds the late W. W. Moore. Danforth joined the firm in 1940 after receiving his electrical engineering degree from the University of Maine.

Pennsylvania Transformer Co, Canonsburg, Pa., has announced appointment of J. B. Sullivan as manager of Syracuse district sales and the opening of a company office at 472 S. Salina Street, Syracuse, N. Y.

Westinghouse Electric Corp's Lamp Division has made the following appointments: L. M. Wallace, Jr, formerly regional sales engineer for Southwestern Region, was named manager of the St. Louis Lamp Sales District, which includes Arkansas, southern Illinois, eastern Missouri, western Tennessee, and northern Mississippi. J. C. Gilmore, manager of the St. Louis District since 1951, was made manager of the Texas Lamp Sales District with headquarters in Dallas. The Texas district covers Texas, New Mexico, and eastern Arizona. R. K. Leonard, recently manager of the Texas district, was named manager of the South Pacific Lamp Sales district headquartered in Los Angeles.

Mycalex Corp of America, Clifton, N. J., has assigned three new managers to newly opened sales offices in Los Angeles, Chicago, and Minneapolis. Kenneth V. Tindall was named manager of the Pacific Sales Division at 5657 Wilshire Blvd., Los Angeles. This unit will serve California, Oregon, Washington, Utah, Idaho, Montana, Wyoming, Colorado, New Mexico, Arizona, and Nevada. Leslie F. Thompson was appointed manager of the Chicago office at 6677 N. Northwest Highway. This unit will serve Illinois, Indiana, Iowa, and the eastern half of Wisconsin. D. A. Schultz heads the Minneapolis office which will service Minnesota and western half of Wisconsin. This office is located at 801 S. E. 8th St., Minneapolis.

Graybar Electric Co, Inc, has announced these district changes, effective Jan. 15: H. G. Cook was appointed district manager for the Detroit district to replace E. R. Yonkers, who has been made district manager at Cincinnati. W. T. Bronson was named manager at Grand Rapids to succeed Cook. Replacing Bronson as manager at Lansing is H. G. Mitchell, manager of inside construction sales at Cincinnati since August, 1953. Effective Jan. 1, J. E. Carroll became Graybar's district manager at Pittsburgh to succeed Douglas Wallace, who was recently made assistant vice president at the firm's New York headquarters.

National Vulcanized Fibre Co's newly opened sales office in Newark, N. J., will be headed by Samuel Sinclair, formerly of the New York office. This new office, located in the Industrial Office Bldg. will serve the expanding northern New Jersey industrial area.

Sola Electric Co, Chicago, appointed J. R. McGovern as district sales engineer at the firm's office in Toronto, Ont. McGovern, an electrical engineer, will handle the company's complete line of specialty transformers in Manitoba, New Brunswick, Nova Scotia, Ontario, Prince Edward Island and Quebec.

REPRESENTATIVES

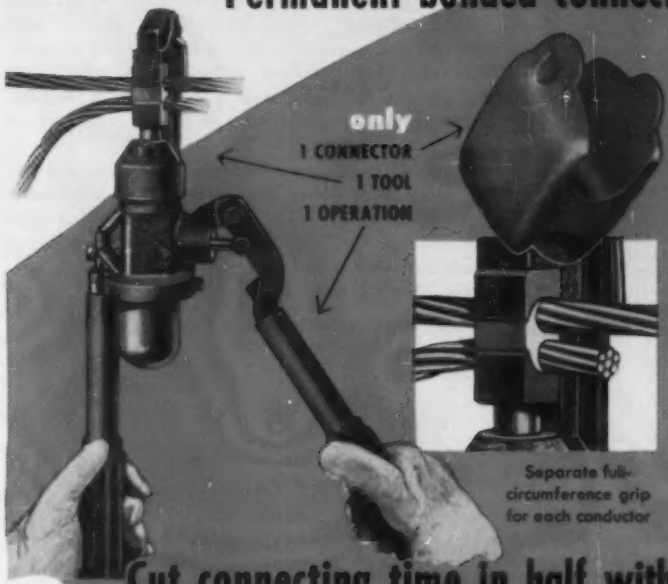
Spang-Chalfant Division of National Supply Co has announced the appointment of Hugh L. Bargion of Honolulu as its representative in Hawaii, Margion, formerly active in the electrical supply field in Hawaii, previously did sales work for Westinghouse Electric Corp in Montana, California, and Oregon, and Washington Water Power Co.

Ebert Electronics Corp, Queens Village, N. Y., has designated Kriegner Sales Co, 300 South Broadway, Camden, N. J., as its representative for the Ebert line of mercury plunger relays. Frank Kriegner, head of the agency, has been covering the territory of eastern Pennsylvania, Delaware, and southern New Jersey since 1947.

Pennsylvania Transformer Co, Canonsburg, Pa., has appointed these two representatives: Williams & McKinley Sales Co, with offices at 1012 Baltimore Bldg., Kansas City, Mo., will handle Kansas and western Missouri. Deco Engineering Products, whose offices are located at 1112 Locust St., Des Moines and 2701 S. 60th St., Omaha, will cover Nebraska and western Iowa.

It's a breeze...just squeeze!

Permanent bonded connections at less cost



Separate full-circumference grip for each conductor

Cut connecting time in half with

SQUEEZONS

and COMPRESSION CONNECTORS

Your line crews can handle any job in half the time with just one Squeezon tool and two types of connectors. The aluminum and solid copper connectors meet *all* line requirements, as shown on this page.

Squeezon connectors provide a *separate*, full-circumference grip on each cable, eliminating galvanic corrosion on transfer surfaces.

QUICK-SERVE BIN BOX
(Patented)
Squeezons are easily accessible in these handy boxes.

Copper Squeezon
One operation of the Squeezon compression tool permanently bonds this type of joint.

Aluminum Squeezon
Aluminum connector for aluminum conductor provides large area contact—prevents cold flow, copper to aluminum. No special connector necessary.

For T Connections
Costly special connectors are eliminated by the use of Kearney Squeezons for aluminum-to-aluminum connection.

Service Entrance Sleeves
for high-pressure connecting of secondary to meter loop.

Dead-Ends
When multiple connectors are used, Squeezons really save time.

Stirrup Tap
Two Squeezons and a short piece of wire make an inexpensive, easy-to-install stirrup; insure a rigid, arc and corrosion-proof connection on hot lines.

Line Splice
Line splices are better electrically and mechanically with Squeezon sleeves.

JAMES R. KEARNEY CORPORATION, 4224-42 Clayton Ave., St. Louis 10, Missouri
Canadian Plant: Guelph, Ontario

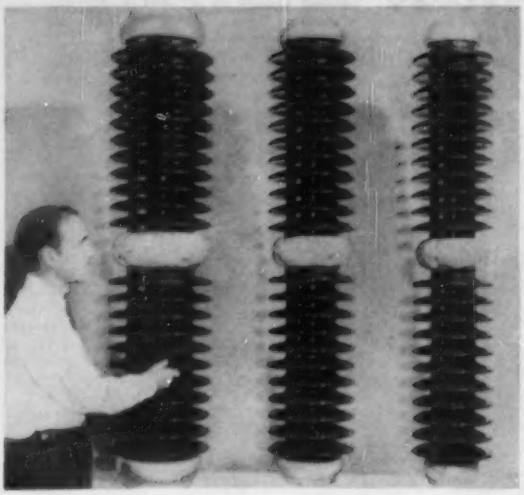
262

Specify

KEARNEY Products

For Better Construction . . . For Safer Maintenance

NEW EQUIPMENT



Post Insulators

Three 161-kv station post insulators are now available in standard strength (1,200-lb cantilever rating), high strength (1,700 lb), and extra-high strength (3,500 lb) units.

These two-piece porcelain posts have standard bolt circles, top and bottom, requiring no adapters. Regular hex head bolts replace Allen head screws, and four of them make a stack instead of 32.

Elimination of joints has increased stiffness, and improved margins of safety over-ratings, both electrically and mechanically. Fewer joints and less weight cut costs of assembly and handling. Their sturdiness assures better operation of switches and other equipment.

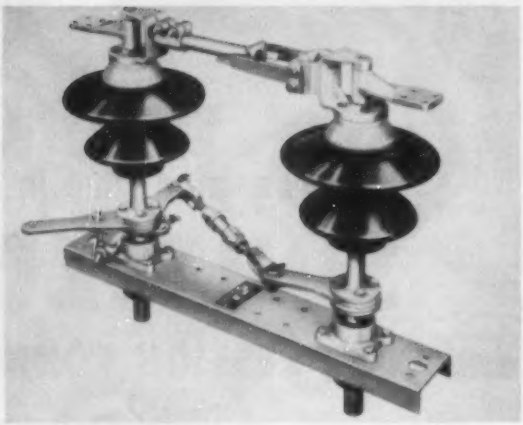
Lapp Insulator Co, Inc, Le Roy, N. Y.

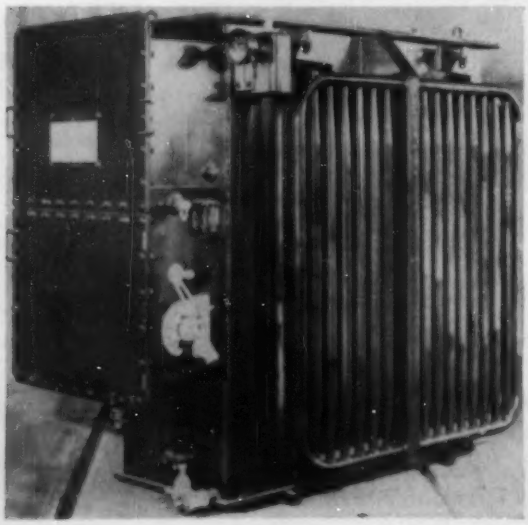
Center Break Air Switch

Type DR center break air switch has been completely redesigned to feature some characteristics common to horizontal and vertical break switches. Sealed pressure hinge contacts have replaced flex connections at the swivel jaw and swivel hinge terminals. Pressure finger jaws designed with a combination copper and beryllium copper provide for high conductivity, strength, resiliency, and thermal capacity.

Type DR switch is built in voltages from 7,500 to 161,000 with current ratings from 400 to 1,200 amp.

R & IE Div, I-T-E Circuit Breaker Co, Greensburg, Pa.





Network Transformer

A vault-type network transformer incorporates tank bracing with tubular radiation to yield extra strength and ease of maintenance. It is available in all network transformer ratings.

The transformer's box-like tank brace serves as a manifold connector for the radiator tubes. The box structure stiffens the tank wall and makes cleaning and repainting easier by leaving space between the tank and tubes.

Corrosive problems are reduced because dirt-collecting surfaces have been reduced. Leakage is minimized, for example, on the 500 kva unit—there are 16 instead of 56 openings for tubes, and because welds are easier to make.

General Electric Co, Schenectady 5, N. Y.

(*More New Equipment on page* 142)

IT HOLDS!

Like "A Steel Hand in a Velvet Glove!"

Hubbard Guy Clamps exert a full and even pressure on the guy for the full length of the clamp.

The straight grooves fit any and all twists, right or left hand, and any variation in diameter, without creating high spots or lessening the clamping area.

There are no sharp edges, and the grooves are smoothly bell-ended, to protect the strand from injury at all points.

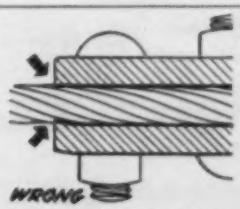
High carbon bolts prevent stripping or elongation. Heads are locked against turning while tightening, and the whole clamp is given maximum resistance against corrosion by the famous Hubbard Double-Dip Hot Galvanizing process.

Clamping area reduced by warped section. Causes slippage at low strains. (Illustration slightly exaggerated)

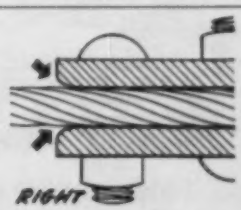
Hubbard Clamps have full clamping area. Hold to breaking strength of most strands.

High spots in clamp reduce clamping area, cause slippage and injure strands.

Hubbard Clamps fit snugly over any and all twists right or left and variations of diameter.



Sharp edge from sheared section injures and weakens the guy at end of clamp.



Rounded ends of Hubbard Clamp sections protect strand.

HUBBARD AND COMPANY

PITTSBURGH • CHICAGO • OAKLAND CALIFORNIA

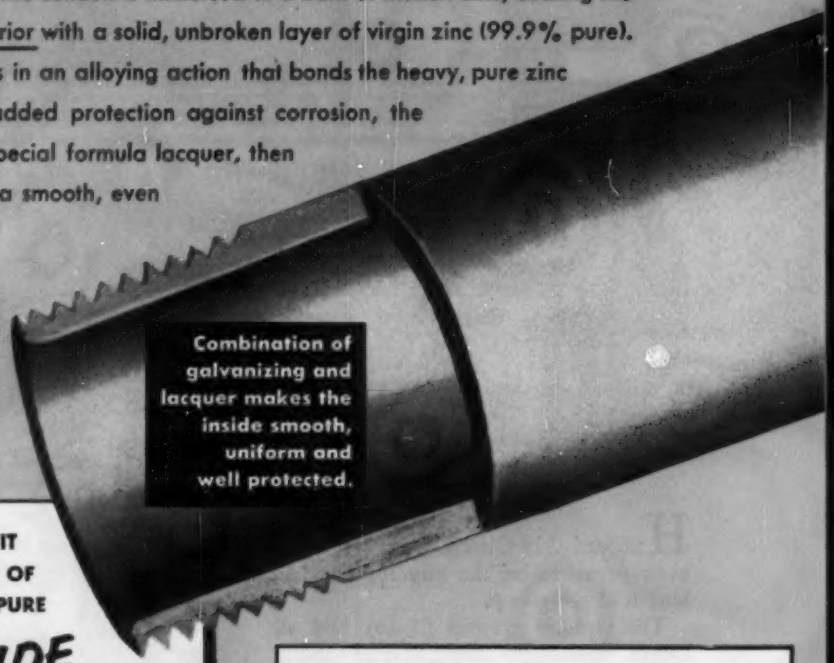
Hang the Load on Hubbard Hardware!

Here are the facts about Triangle's Hot-

Triangle Hot-Dip Galvanized Rigid Steel Conduit is produced from choice sections of the highest grade ingots. This insures a perfect base for proper bonding of the zinc. Every length is thoroughly scoured and pickled in acid, leaving the pipe perfectly clean before the application of the protective zinc coating.

When perfectly clean, the conduit is immersed in a bath of molten zinc, coating the interior as well as the exterior with a solid, unbroken layer of virgin zinc (99.9% pure). The hot-dip process results in an alloying action that bonds the heavy, pure zinc coating to the pipe. As added protection against corrosion, the conduit is submerged in special formula lacquer, then baked, giving the conduit a smooth, even finish.

Conforms to Federal Spec. WWC-581b (Galvanized)



Combination of galvanizing and lacquer makes the inside smooth, uniform and well protected.

EVERY LENGTH OF CONDUIT IS IMMERSED IN A BATH OF MOLTEN ZINC — 99.9% PURE

INSIDE AND OUTSIDE

Every square inch of the conduit — inside and outside — is thoroughly and uniformly coated with pure zinc. Remember, because of condensation, the inside of conduit is just as subject to corrosion as the outside. That's why it's important to specify Triangle Conduit — protected inside and outside.

HOT-DIP GALVANIZING IS UNIFORM NOT TOO THIN-

Coatings that are too thin in even one spot, are likely to develop tiny pin-point holes through which corrosion can creep. There is no possibility of thin spots in zinc applied by the Triangle hot-dip galvanizing method. The thickness of the zinc coating is uniform — *exactly* the same from one end to the other. Hot-dip galvanized coating is two or three times as thick as other coatings.

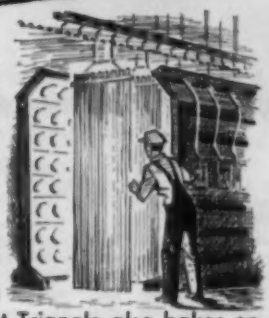
Dip Galvanized Conduit.

NOT TOO THICK-

If the coating on conduit is too thick, it is subject to cracking and flaking when being bent. Careful controls keep the coating of Triangle Conduit at just the *right* thickness — always.

Never too thick — never too thin.

AND AN EXTRA BONUS!



A clear lacquer is applied and baked on the conduit. Not only does Triangle apply the best protective coating (molten zinc) but Triangle also bakes on an additional transparent lacquer of special formula. The application of this baked-on coating insures a permanently smooth interior (for easy pulling) and also provides additional protection against rust or corrosion. It also protects the conduit during shipment.

TRIANGLE CONDUIT is Hot-Dip Galvanized—

and TRIANGLE'S Hot-Dip Galvanizing has never been surpassed!

TRIANGLE CONDUIT & CABLE CO., INC. New Brunswick, N. J.

Manufacturers of Arteries for Electricity, Liquids and Gases

WIRE • CABLE • CONDUIT • PLASTIC PIPE • BRASS AND COPPER TUBE

Plants—New Brunswick, N. J.: Wire and Cable Plant, Rod Mill, Brass and Copper Tube Mill, Plastic Pipe Plant. Moundsville, W. Va.: Conduit Plant.

"It MUST Be Right!"

NEW IDEAL
Tap Connectors
CONSTANT
RESILIENT
PRESSURE
Keeps Joints Tight

● IDEAL Tap Connectors give you a tighter, stronger connection that is continuously under spring tension. Because they are made of resilient, cold-worked steel (zinc dipped) their grip is not affected by temperature changes and contraction or expansion of either the wire or connector. Their unique design also provides *more* contact area, *more* mechanical strength, *greater* pressure on the joint. Contacts are better, wires can't work loose, burnouts are practically eliminated.

IDEAL Tap Connectors are easier to use. There are no parts to come loose, just a single unit to handle. Easier to stock, too, because only three sizes handle all wire combinations from 2 No. 1 wires to one No. 10 and one No. 12 or one No. 8 and one No. 14. Available *without* spacer bars for copper-to-copper or aluminum-to-aluminum, *with* spacer bars for copper-to-aluminum, copper-to-steel or aluminum-to-steel.

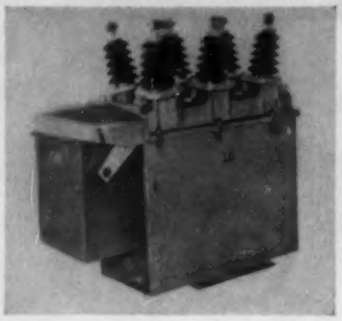
COST LESS! IDEAL Tap Connectors are lower in price than other connectors for practically every combination.

ASK YOUR IDEAL DISTRIBUTOR OR MAIL COUPON FOR FREE CATALOG DATA
SOLD THROUGH LEADING DISTRIBUTORS
Canadian Distributor: Irving Smith, Ltd., Montreal

IDEAL INDUSTRIES, Inc.
1021 Park Avenue, Sycamore, Illinois
Please send catalog data on IDEAL Tap Connectors
Name
Company
Address
City Zone State

New Equipment

(*Continued from page* 138)

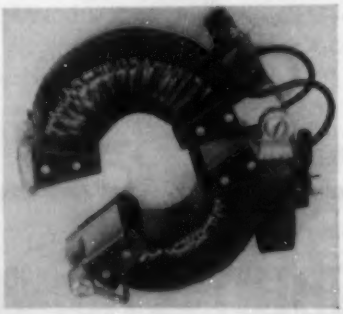


50-Amp Recloser

A 50-amp recloser for 2.3 to 15.5-kv distribution systems has been designed for use where larger interrupting capacity is not needed. It is particularly adapted for use with sectionalizers to provide coordinated fault protection on lightly loaded distribution lines.

The Type 50-GR-3 permits choice of one instantaneous and three time-delay trips, two instantaneous and two time-delay trips, or four time-delay trips. Suitable for manual or solenoid operation, the single-tank three-pole unit mounts directly on the pole.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.



Current Transformer

A Knopp split-core current transformer, Type W-400 has been designed for use with a rotating standard for accurately measuring and integrating electric power. It also can be used with indicating ammeters and volt meters.

It offers uniform ratio and phase-angle performance from light-load to more than full-load current. This is particularly desired when integrating wattage measurements are being made on fluctuating loads.

Its primary ranges are 200 and 400 amp, and it has a one- or five-amp secondary. It is designed for 600 or 2,500 v.

The ratio at full-load is within plus-or-minus 0.15% and the phase-angle within three minutes leading. Between 20% and 100% of full-load current, the ratio slope does not exceed 0.05% and the phase-angle slope does not exceed three minutes.

An accessory 40-turn primary coil provides the following additional ranges: 100, 50, 40, 20, and 10 amp.

Electrical Facilities Inc, 4236 Holden St, Oakland 8, Calif.

Industrial TV

A cigar-box size television camera has been developed to keep an electronic eye on things to be watched in industry and commerce. Tel-Eye sends closed-circuit pictures by cable to screens of standard television receivers, using any of the commercial low-band VHF channels (2 to 6).

Operating under normal room lighting conditions, the camera can be plugged into 117-v ac outlet. Its output connects to antenna terminals of a standard TV receiver. No intermediate units are needed between camera and receiver. It can be set up and connected in minutes without technically trained personnel.

Camera adjustments can be controlled at a distance by a remote-control accessory. A special remotely controlled pan and tilt unit is also available.

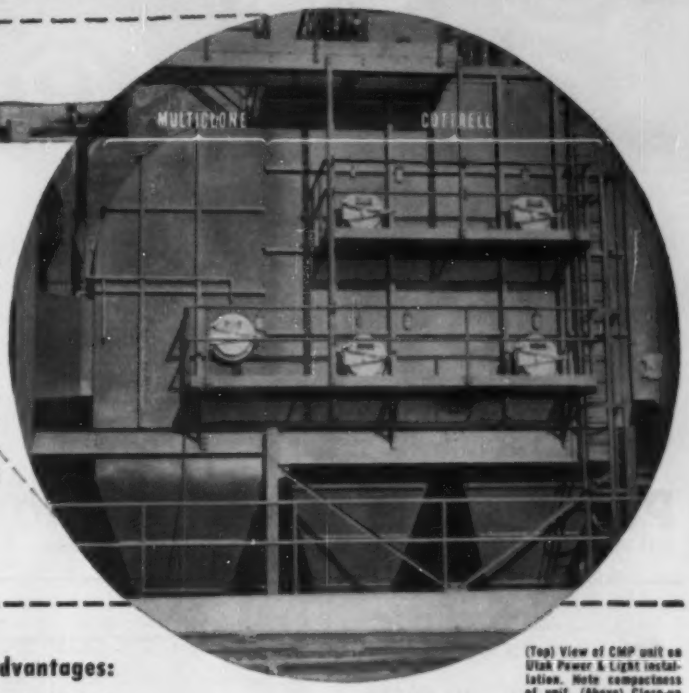
Allen B. Du Mont Laboratories, Inc, 750 Bloomfield Ave, Clifton, N. J.

Fire Extinguisher

A streamlined fire extinguisher can expell 10 lb of dry chemical to help snuff fires in flammable liquids, gases, chemicals, and electrical equipment. The Ansul-10 weighs 22 lb, and goes into operation when user applies additional hand pressure to puncture its CO_2 pressure cartridge.

(*Continued on page* 144)

Consider these important advantages of a WESTERN PRECIPITATION CMP UNIT!



IF YOU are planning the installation of any type of fly ash recovery equipment—mechanical or electrical—it will pay you to investigate the extra advantages to be gained by installing a CMP Unit designed, engineered and constructed under *one* responsibility by Western Precipitation Corporation—*leaders in both electrical and mechanical recovery fields!*

(Top) View of CMP unit on Utah Power & Light installation. Note compactness of unit. (Above) Close-up of same installation.

Combines Mechanical and Electrical Advantages:

A CMP (Combination Multiclone-Cottrell Precipitator) Unit combines—in one compact installation—both mechanical and electrical recovery principles, so that maximum benefit is obtained from the advantages inherent in each method. The MULTICLONE section centrifugally cleans the gases of the larger and heavier fly ash particles (down to a few microns in diameter)... and the COTTRELL Precipitator then electrically removes the very small particles remaining in the gases. This combination arrangement has important advantages:

1. Using the MULTICLONE for cleaning out the heavier particles permits the bulk of the recovery operation to be performed with relatively low-cost equipment.
2. Using the COTTRELL for final clean-up insures unusually high recovery efficiency—approaching theoretically perfect, if desired—with a high efficiency, compact Precipitator unit.
3. Each type of unit—MULTICLONE and COTTRELL—can be arranged for its most efficient application. MULTICLONES may be connected to each separate boiler, if desired, and their draft requirement cut out when the boiler is down... while a central COTTRELL handles all gases and operates at higher efficiencies, with continued low power cost, when one or more boilers are down.
4. During soot-blowing periods, or while warming up cold boilers, the MULTICLONE efficiency usually increases, preventing overloads of detrimental carbon from reaching the COTTRELL.

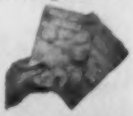
Only Western Precipitation Combines Multiclone and Cottrell "Know-How"—In ONE Organization!

A vital factor in obtaining maximum efficiency and economy in CMP installations is the proper balance of mechanical and electrical recovery equipment to the individual requirements of *each* application. Western Precipitation is unique in that it not only pioneered the commercial application of COTTRELL Electrical Precipitators over 43 years ago, but also has been a leader for many years in the *mechanical* recovery field with its widely-recognized MULTICLONE Collectors.

Result—Western Precipitation has the all-important "know-how" and experience in BOTH fields... knows from first-hand experience how to fit the *right* equipment in the *right* place, to do *your particular* job ... and can provide the complete installation under ONE responsibility and ONE overall guarantee!

Let Our Experienced Engineers study your recovery requirements and make recommendations on the equipment best suited to your operations. A wire, phone call or letter to our nearest office places this unique "Know-How" at your service, without obligation!

Send for descriptive literature!



WESTERN Precipitation CORPORATION

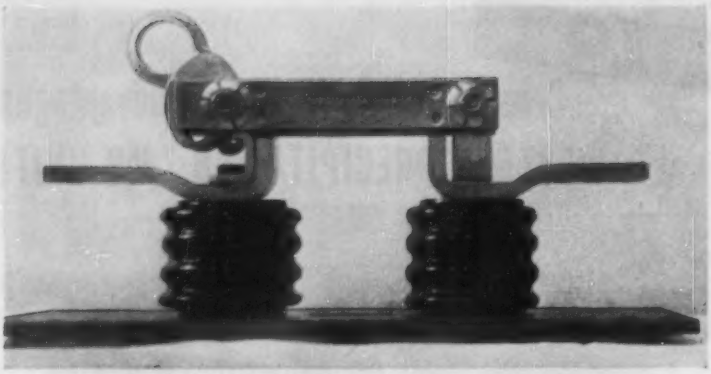
DESIGNERS AND MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1004 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA

CHRYSLER BLDG., NEW YORK 17 • 1 N. La SALLE ST. BLDG., CHICAGO 2

1429 PEACHTREE ST. N.E., ATLANTA 5 • HOBART BLDG., SAN FRANCISCO 4

PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL



DISCONNECTING SWITCHES

Simplicity of Design Assures Greater Dependability . . . .

Powercraft disconnects are built with a current path of solid bus bar copper for uniformly high conductivity and thermal capacity. High unit pressure "silver Ball" contacts assure low temperature rise and ease of operation. Simple short-circuit-proof lock, hook-stick operated.

Other POWERCRAFT Products: Gang-operated Switches and Bus Supports for Indoor and Outdoor Applications. Bus Clamps. Power Connectors. Pipe Frame Fittings for 1¼" I.P.S. Pipe.

• *Send for our new catalog.*

POWERCRAFT CORPORATION

2215 DeKalb Street — *Since 1932* — PRospect 6-4532 — St. Louis 4, Mo.

Save up to 85%

brush handling costs

M & M Brush Grinder rapidly converts brush to chips and reduces piling, trucking, and burning costs.

Cut labor and truck operating costs as much as 85%. M & M Brush Grinder chews brush and branches up to 6" in diameter into small chips and automatically blows them over the ground or into a truck. Compact, portable unit with its own power plant. Haul it right to the job by jeep, or truck. Fully enclosed mechanism is protected from dust and dirt and completely safe. Sturdy construction for long, satisfactory service. Write today for illustrated folder.

MITTS & MERRILL 1002 South Water St. • Saginaw, Michigan

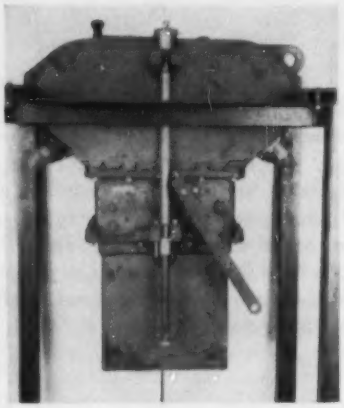
85

New Equipment

(*Continued from page* 142)

Fire Underwriters, the extinguisher has a new-style fill cap that is said to be more effective in keeping moisture out of the extinguisher shell, and a new easy-to-operate squeezable nozzle. The unit is also less subject to vibration on vehicles.

Ansul Chemical Co, Marinette, Wis.



Subway Oil Switch

Type MS 5 subway oil switch has been redesigned for service disconnecting and isolation of network sections. It will slip through a manhole opening of 30 in. dia in subway construction. Rated at 13,800 v and 600 amp, the switch's drawout design permits inspection and maintenance without disturbing the lead-covered cables and wiping sleeves. It is a triple-pole switch with individual wiping sleeves for cable connection.

A safety servicing-interlock prevents removal or insertion of switching mechanism with switch in closed position. Barriers permit disconnection of cables on one side while the other side remains energized.

Roller-Smith Corp, Electrical Switchgear Div., Bethlehem, Pa.

Traffic Light Bulb

A 75-w bulb for traffic lights has two filaments so that it glows on 25-w after the 50-w filament burns out. The dim light is enough to direct pedes-

(*Continued on page* 148)

SQUARE D *Reduced Voltage* STARTERS

One of these 4 types will meet your requirements . . . best

- Is minimum motor current inrush your primary consideration?
- Is it reduced starting torque? Or maximum smoothness in acceleration?
- Is cost an important factor?

With these four types Square D can meet any reduced voltage starter requirement—exactly.

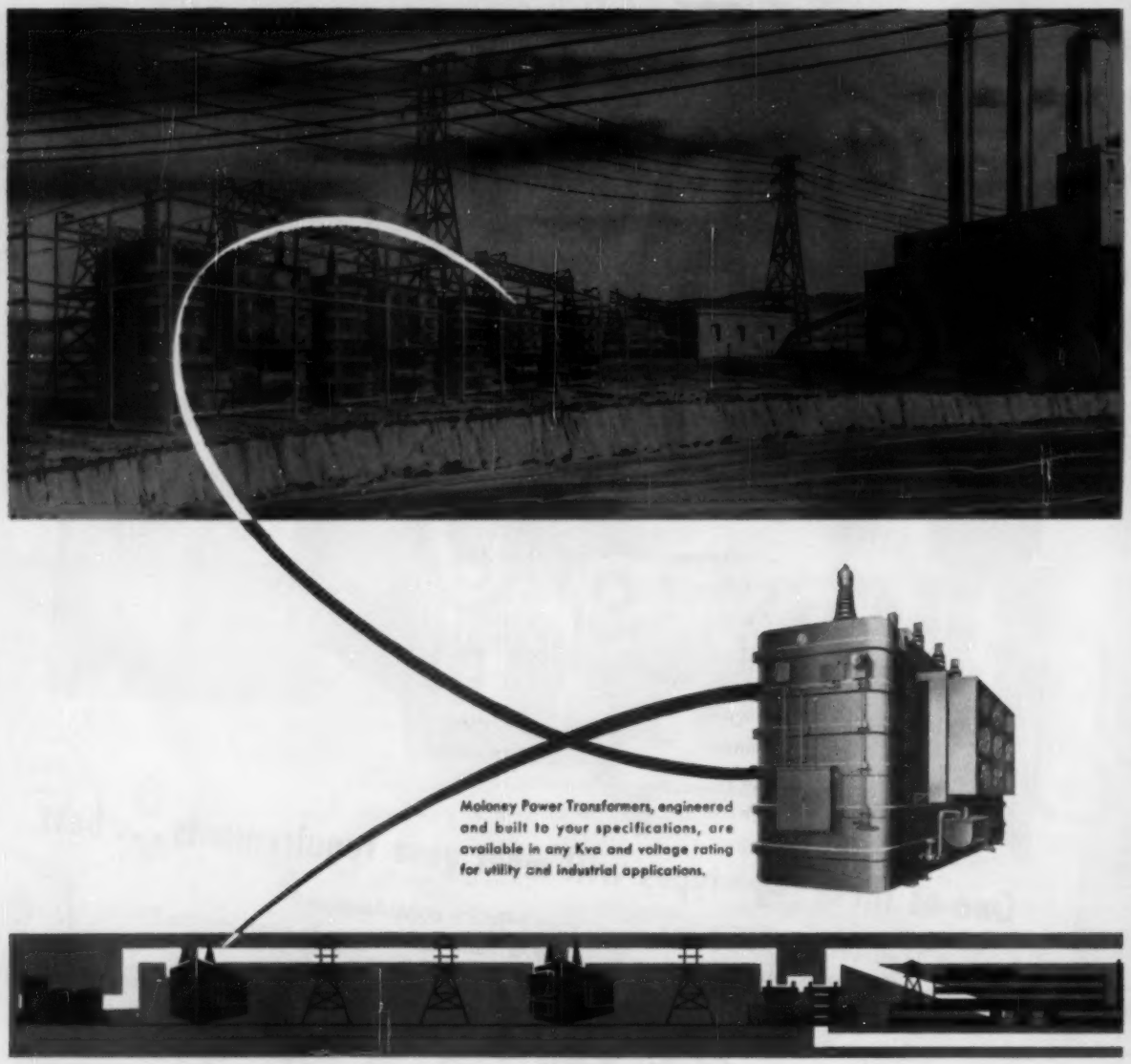
Write **for Reduced Voltage Starter Bulletins. They give complete details.**
Address Square D Company, 4041 N. Richards Street, Milwaukee 12, Wisconsin.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

MOLONEY ELECTRIC

MOLONEY..



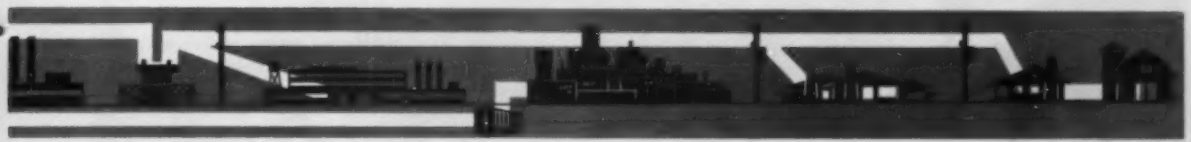
Moloney Power Transformers, engineered and built to your specifications, are available in any Kva and voltage rating for utility and industrial applications.

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES

For years the name Moloney on a transformer has meant a better product. As utilities have grown and become more complex, so have transformers. All this expansion in the power field has been paralleled by expansion here at Moloney. Many utilities feel that Moloney Transformers are the best you can buy. They are right, because—

. . ALL ALONG THE LINE!

Take, for instance, Power Transformers; Today utilities demand transformers in higher Kva and voltage ratings. Yet, while Kva and voltage ratings are greater, and still growing, certain factors such as size are still limited. To keep pace with utility demands, Moloney expanded its facilities and developed new and improved designs to fit today's *and* future needs. Transportation limitations have influenced transformer design. To overcome these limitations, Moloney Engineers adopted shielded concentric layer type high voltage coils. Concentric layer high voltage windings possess both high mechanical strength and high impulse strength. With this type winding it is now possible to produce transformers of today's or tomorrow's ratings, within space limitations of present transportation systems.



MOLONEY ELECTRIC COMPANY

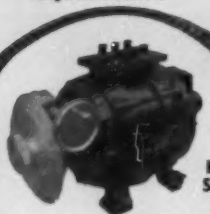
Power Transformers • Distribution Transformers • Step Voltage Regulators • Regulating Transformers • Load Ratio Control Transformers • Unit Substations • Network Transformers • Constant Current Transformers • Capacitors • Transformers For Electronics

AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA

THE STATES COMPANY

TESTING . . .

EQUIPMENT



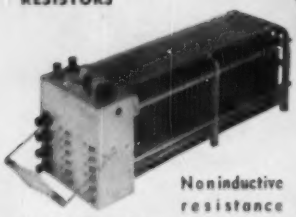
PHASE SHIFTER Type R

Made in 50 to 2500 volt ampere capacities. Provides means for shifting phase continuously for every possible angular displacement. May be obtained as combination of phase shifter and induction regular.

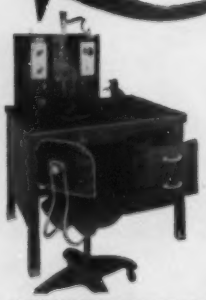
Type WR

Ohm-spun

RESISTORS



Noninductive resistance loads. Controls current free from wave distortion due to inductance. Light in weight but durable.



Form "FHAPBL"

A compact table for use as either a test or work table. Desk 40" wide. Fully equipped for all around watthour meter testing.

THE STATES COMPANY

I am interested. Please send further information on:

☐ OHM—Spun Resistors Type WR

☐ Phase Shifters ☐ Test Tables

Name of Firm .....

Title .....

City ..... Zone ... State .....

New Equipment

(*Continued from page* 144)

trians and traffic until a police patrol or the city's maintenance department replaces the globe. The 50-w filament is designed to have a 5,000-hr life; the 25-w filament, 8,000 hr. The Dual Traffic Signal lamp has an A-21 bulb on a medium base. The bulb may be used in any position in traffic, railroad and airport signals.

Solar Electric Corp, Warren, Pa.

Plastic Line-Tent

A one-man tent of translucent plastic for utility and telephone line crews is designed for aerial work, splicing, or as a manhole cover.

It is light weight, easy to handle and offers protection from sun and foul weather. It permits full transmission of daylight for the work at hand.

Weighing 13 lb, the plastic tent can be erected or taken down by one man. It is completely waterproof, and fireproof, and resists the attack of acids, oils, and gasoline. All seams are electronically welded. Strain points are reinforced. Brass grommets and rope loops are provided for tying down.

Protection against high voltage is provided by the high dielectric strength of 9,600 to 16,000 v, depending on thickness of the material. Insulation resistance has been measured at 1.4 x 10^9 megohms per cc.

A larger tent for 2-man splicing crews and for covering extension ladders and "Baker" boards is also being manufactured.

Plastimayd Products Corp, 931 S. E. Sixth Ave, Portland 14, Ore.

Millivoltmeter

An indicating millivoltmeter features short response time as a result of a high-torque jeweled mechanism using an Alnico V magnet and a self-supporting coil. A neutralizing resistance compensates for changes in coil resistance due to ambient temperature changes.

The Model 580 indicating millivoltmeter's accuracy is 1% of full-scale value. Minimum response time is less than 6 sec for 99% response. The instrument can be used with any primary sensing device capable of supplying a millivolt signal to the indicator. Ask for Bulletin P1244.

Bristol Co, Waterbury 20, Conn.

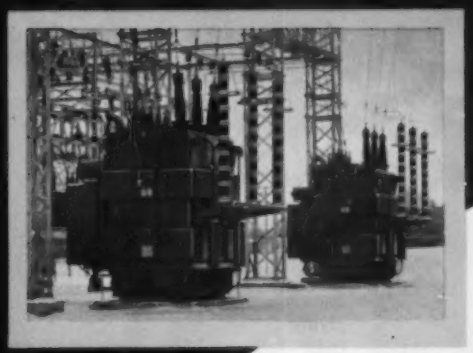
Watthour Meter

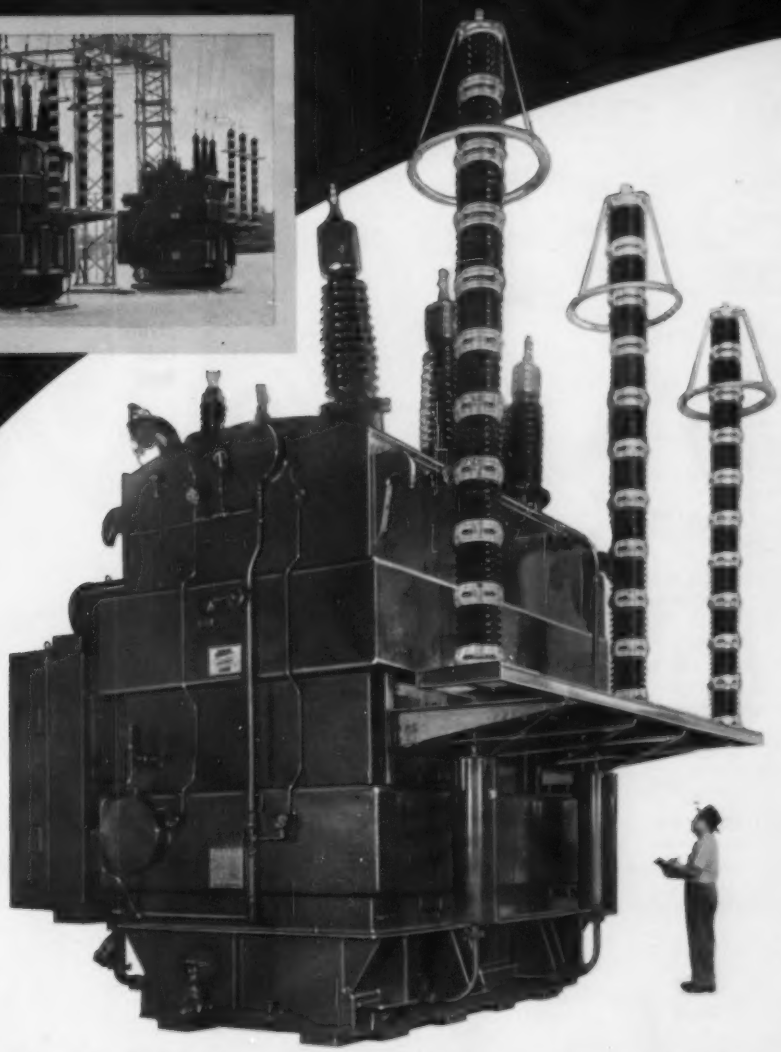
An extended range watthour meter capable of handling loads up to 667% of nameplate rating retains such features as a magnetically suspended rotor, unit construction, coordinated insulation, and corrosion-resistant materials, and has a unique retarding system.

The I-55's current coil is equipped with heavier copper windings, and brazed terminal leads which provide 100-amp capacity with a normal temperature rise of 55 C. The potential coil is wound on a molded nylon

(*Continued on page* 151)

PENNSYLVANIA 40,000 kva *three phase* CONTOUR DESIGN LOAD RATIO CONTROL TRANSFORMER





see next page for inside story

Two identical 40,000 Kva Pennsylvania Load Ratio Control Transformers traveled by train and truck in an upright position to their substation. The transformers were completely assembled except for forced cooling equipment and bushings. Installation was therefore relatively fast and easy, and much of the credit for that goes to Pennsylvania's space-saving, shell-form Contour Design. 32-step tap-changing underload equipment maintains a constant low voltage, with the high voltage varying from 100% to 80% of normal voltage. The transformer has a high voltage rating of 132,000 volts; a low voltage rating of 36,000 volts; and a 13,650 tertiary voltage at 14,000 Kva.

pt

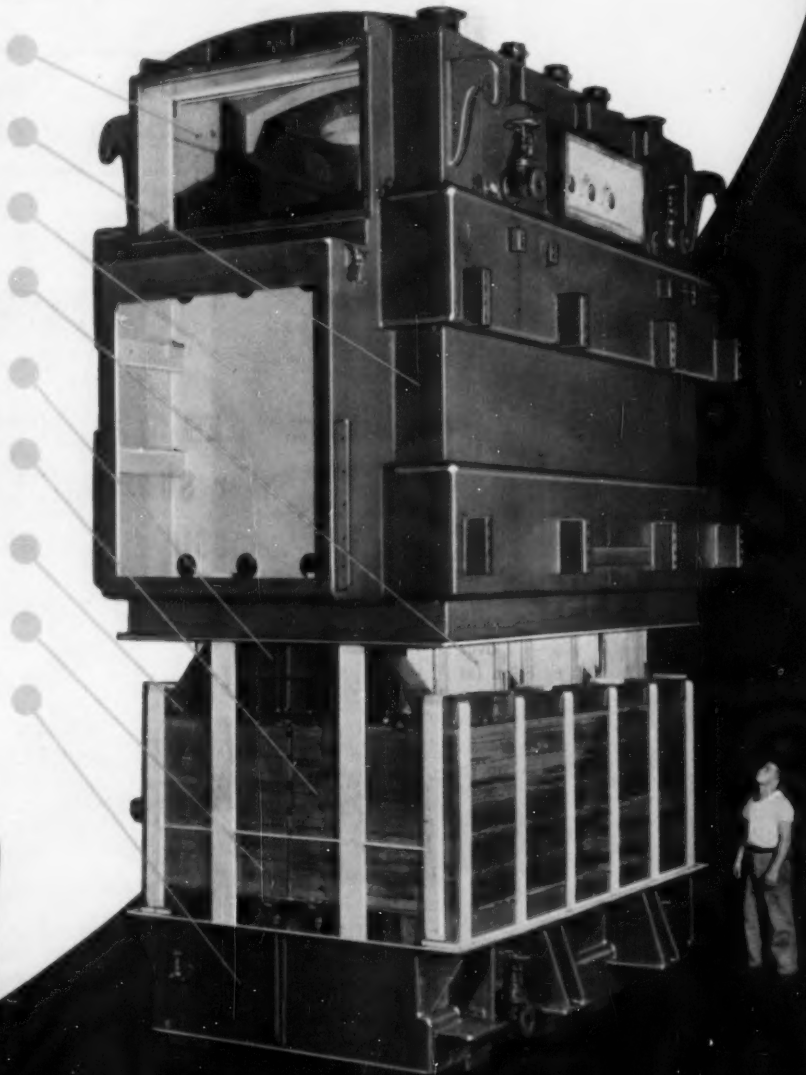
PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division • **CANONSBURG, PA.** • *Greater Pittsburgh District*

Inside a **40,000 Kva** *three phase*

PENNSYLVANIA contour design LOAD RATIO CONTROL TRANSFORMER

40,000 Kva, Three Phase, 60 Cycles, 55°C. Temperature Rise. Forced-oil with forced-air heat exchangers. High voltage: 132,000 Grd.Y. Low voltage: 36,000 Y. Tertiary voltage: 13,650Δ (14,000 Kva). Low voltage windings provided with tap-changing underload equipment for plus and minus 10% regulation in 32-⅝% steps.



Opening for load ratio control mechanism.

Upper Contour Design tank section fits over coil and core assembly and is welded to the bottom tank section.

Compartment for Preventive Auto Transformer.

Vertical cooling ducts in the coils permit a free flow of oil through the coils for most efficient cooling.

Core and coils clamped together with heavy steel frames to form a rigid structure.

Core and coil unit can be handled separately as a complete sub-assembly.

Heavy box sections form part of core frame and clamp coils against mechanical forces during short circuits.

Core cooled by both vertical and horizontal ducts.

Core and coil assembly rests on bottom section of the Contour Design tank.

for exterior view of this transformer

see other side

PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division · **CANONSBURG, PA.** · *Greater Pittsburgh District*

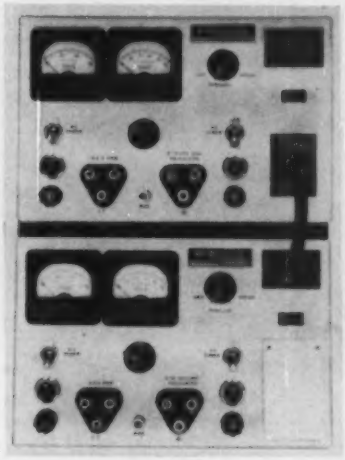
New Equipment

(*Continued from page* 148)

spool, and is equipped with Formex-covered wire which insulates between turns.

Ground pins have been relocated under current leads to maintain desired relief-gap distances. Buna-N rubber gaskets provide proper fitting covers. "Arc over" of the relief-gap occurs at voltages below the insulation level of the meter.

General Electric Co, Schenectady 5, N. Y.



Power Supply

Regulated power supply units can be stacked to conserve space, and can be interconnected for individual, series, or parallel operation. A single unit provides 0 to 250 v from 0 to 100 ma, electronically regulated over the entire range. Series operation (at 250 v per unit) can yield a continuously variable voltage up to 1,000 v with maximum load of 100 ma. Paralleled units can yield a current up to 400 ma maximum load at + or −0 to 250 v. A panel switch selects unit, series, or parallel operation.

The high voltage supply of the unit is continuously adjustable from 250 v or greater to zero, and is regulated within 0.2% or 0.3 v (whichever is larger) from no load to full load, at any line voltage from 105 to 130 v. Maximum ripple and noise is less than 5 mv rms. At any load current, the output voltage is regulated within 0.3% or 0.7 v (whichever is greater)

(*Continued on page* 154)

HIGH STRENGTH ALUMINUM ALLOY
STRINGING BLOCKS
SIDE OPENING
DESIGNED FOR
STRINGING AND SAGGING
ACSR ALUMINUM CONDUCTORS

16 INCH SHEAVE
For ACSR 1,033,500 CM. and smaller
Tension Limit 10,000 lbs
Sealed Ballbearing Sheaves
Weight 18 lbs

10 INCH SHEAVE
For ACSR 397,000 CM. and smaller
Tension Limit 5000 lbs
Oilite Bearings
Weight 9 lbs

TRIPLE SHEAVE
ALUMINUM CROSSARM ROLLERS
Frame and Sheaves—Aluminum Alloy
5 inch x 1½ inch Sheaves
Oilite Bearings
Fits 5 inch and smaller crossarms
Weight 8 lbs

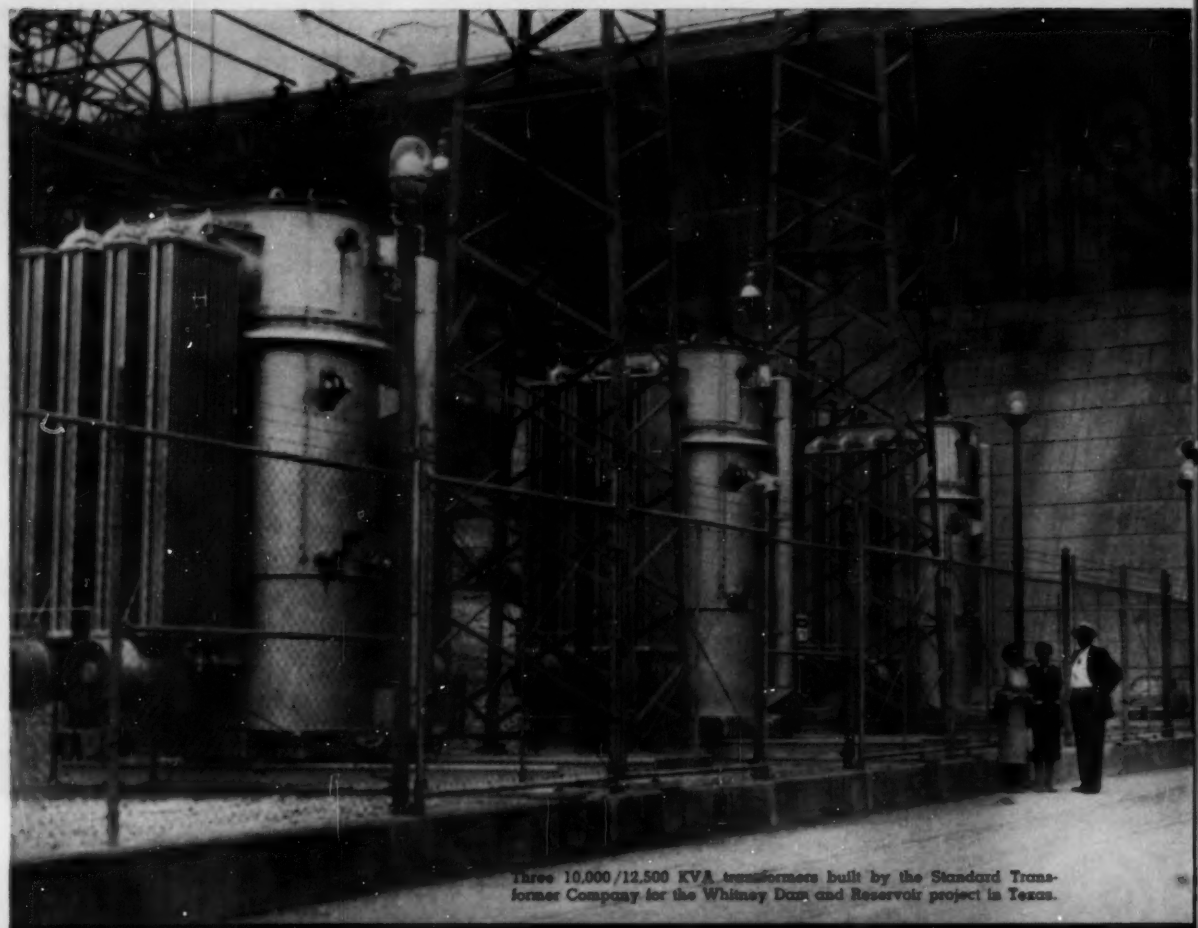
DICKE TOOL CO. 1201 WARREN AVENUE DOWNERS GROVE, ILLINOIS

GALVANIZED STRUCTURAL STEEL for SUBSTATIONS TRANSMISSION TOWERS

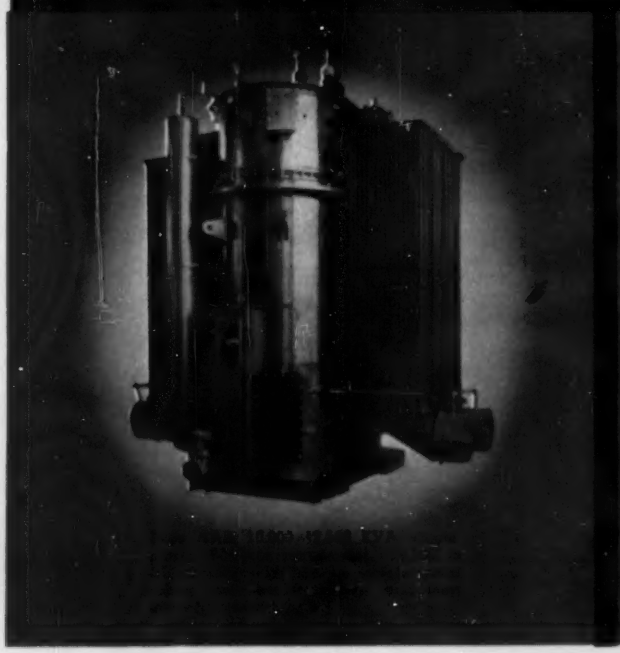
Peak demand up? **Facilities overtaxed?**
Need new suppliers for $ cost and service comparison? Our 18 years experience in serving the electrical industry would be to your advantage.

We offer consultation, scheduling, detailing, fabrication and erection. We will help you meet your needs — anywhere in the United States.

FLINT STEEL
FLINT STEEL CORPORATION
TULSA • MEMPHIS



Three 10,000/12,500 KVA transformers built by the Standard Transformer Company for the Whitney Dam and Reservoir project in Texas.



Standard

TRADE MARK ®

builds

Whitney Dam

Whitney Dam and Reservoir, a Corps of Engineers' project on the Brazos River near Hillsboro, Texas. The project can deliver through the **STANDARD** Transformers 85,000,000 KWH annually.

● There was a time when **STANDARD** built transformers that were no bigger than a pound of butter. Now our engineers take installations like the Whitney Dam and Reservoir project in stride. In the factory, **STANDARD** craftsmen have become accustomed to building large transformers quickly and accurately.

Here are a few statistics. Each 10,000/12,500 KVA transformer at Whitney Dam weighs 40 tons. The transformers are capable of stepping up 13,200 volts to 69,000 volts. They can convert enough power to supply a fair-sized city. There are 2,900 gallons of oil in each, and the elements weigh 40,000 pounds apiece. It takes 6,300 pounds of copper alone for each transformer. They are 18 feet high and are air cooled with fans for 12,500 KVA supplemental rating.

When you have a need for transformers, whether large or small, don't hesitate to call your **STANDARD** representative.

Standard

THE STANDARD TRANSFORMER COMPANY

WARREN, OHIO

REPRESENTATIVES IN PRINCIPAL CITIES

Write for Bulletin CL-53. It tells the story with words and pictures of Standard's complete line of transformers and how they perform for every class of service . . . on the job.

PAGE FENCE - Since 1883

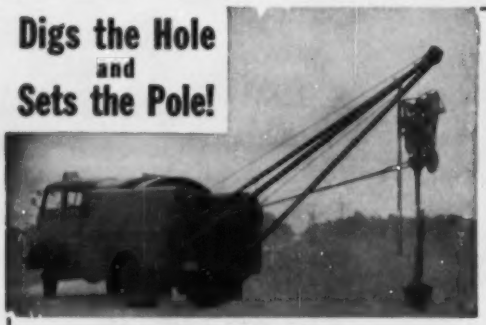
• AMERICA'S FIRST WIRE FENCE •

• Page Chain Link Fence, pioneered by Page and made only by Page, is quality controlled from raw metal to erected fence. Whether you choose heavily-galvanized Copper Bearing Steel, or long-lasting Stainless Steel, or corrosion-resisting Aluminum, you'll have a rugged fence on sturdy metal posts deep-set in concrete. Choose any one of 8 basic styles, varied by heights, types of gates, posts, top rails and barbed wire strands for extra protection. And to be sure of reliable workmanship your fence will be expertly erected by a specially trained firm. For helpful Page data and name of member nearest you...

Write to PAGE FENCE ASSOCIATION in Monessen, Pa., Atlanta, Bridgeport, Chicago, Denver, Detroit, Los Angeles, Philadelphia, New York or San Francisco.

PRODUCT OF PAGE STEEL & WIRE DIVISION OF AMERICAN CHAIN & CABLE COMPANY, INC.

Digs the Hole and Sets the Pole!



The F & H Self-Powered Hole Digger digs a hole 6' deep in about 4 minutes. Will dig 10' deep. Powered by Briggs & Stratton 8 HP engine. Can be operated by one man. Has own power for raising, lowering, and turning auger. Multiple V-Belt drive eliminates troublesome power takeoffs and universal joints. Can be mounted on any type A Frame. Just hang it on your A Frame and you are all set to dig holes. Write for illustrated literature today.

Manufactured and Sold by

FOUSHEE and HECKENDORN — Cedar Point, Kansas

SPECIFY

Grip-Tite

EXPANDING ANCHORS

GRIP-TITE MANUFACTURING CO.

WINTERSET, IOWA

"Pioneers in the Anchor Field"

New Equipment

(*Continued from page* 151)

for line changes from 105 to 130 v.

The regulated power supply is available in Models 1100 and 1101; Model 1101 is equipped with an additional 0 to 150-v variable, regulated bias supply, 5 ma maximum load.

RS Electronics Corp, 435 Portage Ave, Palo Alto, Calif.

MORE NEW PRODUCTS

about which you should know

Insl-X Sales Co, 26 Rittenhouse Place, Ardmore, Pa. announces three **coil impregnants** for impregnating and sealing coils and precision type resistors, including those made of fine wire. Ask for Bulletins A-107, E-67, and Q-101.

Eastern Specialty Co, Philadelphia 40, Pa., has Type RC-50 **artificial load** for testing watthour meters in the field. It yields close control of the current, especially where demand attachments, reactive meters, or loss compensating devices are involved.

Vectron, Inc, 400-12 Main Street, Waltham 54, Mass., has VFS-250 **variable frequency power supply.** Compact and semi-portable, it has a 45 to 2,000 cps current with available output up to 300 va. It is useful, among other things, for controlling synchronous motors and processing equipment.

Shallcross Mfg. Co, Collingsdale, Pa. has expanded its line of lightweight, high-temperature **ceramic resistors** to MIL-R-10566 specifications. Types R31, R32, R34, and R36 are rated at 350 C hot-spot temperature. Ask for Engineering Bulletin L-29.

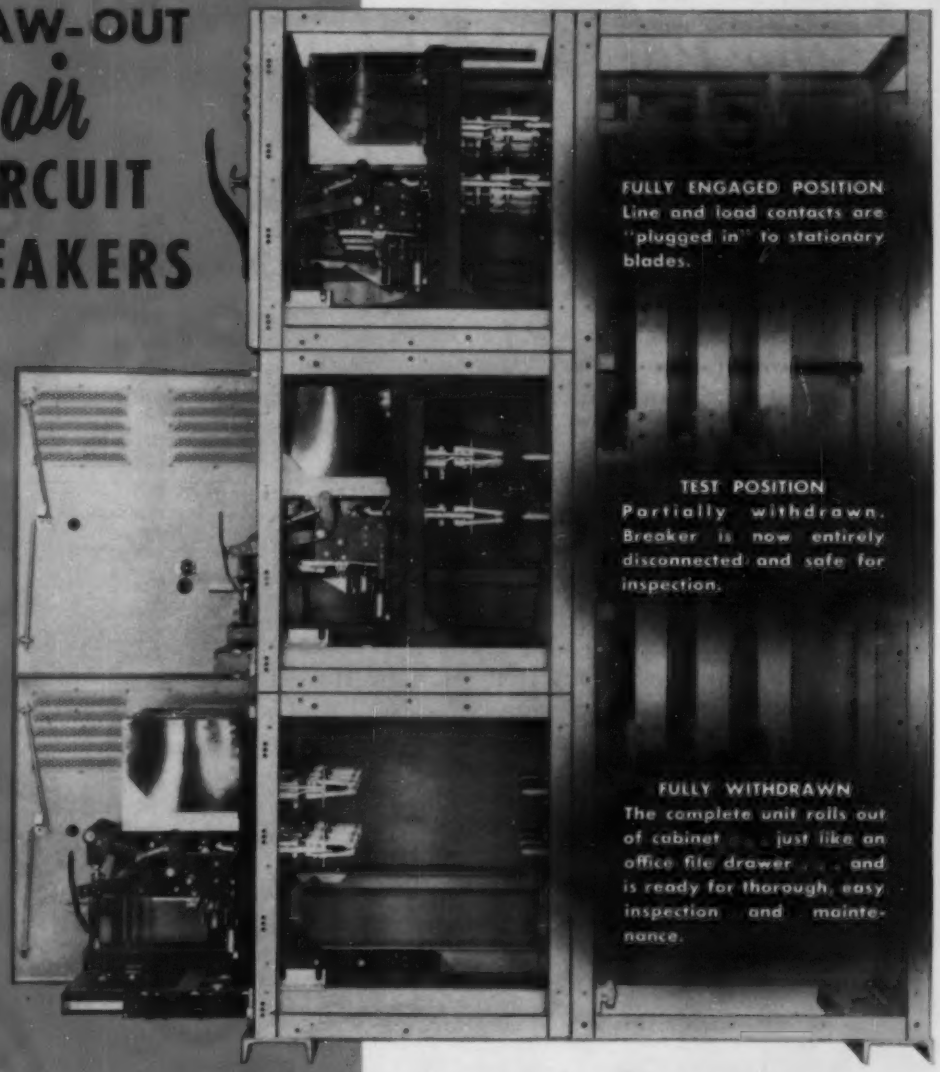
Yale Materials Handling Div. of Yale & Towne Mfg Co, 11,000 Roosevelt Blvd, Philadelphia 15, Pa. announce that its K-51 series of electric **industrial trucks** has won Underwriters' Laboratories type EE rating. Handling up to 10,000 lb, these trucks are suited to places where flammable volatile liquids are used, but where they would be hazardous only in cases of accident or unusual operating conditions.

3 STEPS TO SAFE EASY MAINTENANCE with

Roller-Smith

DRAW-OUT *air* CIRCUIT BREAKERS

"Reading" this picture from top to bottom, you'll see the three easy steps that make Roller-Smith Draw-Out Air Circuit Breakers so safe and simple to install, inspect and maintain. Illustrated, with enclosure side removed, are three 1600 ampere, 600 volt Draw-Out Air Circuit Breakers of 50,000 ampere interrupting capacity.



FULLY ENGAGED POSITION
Line and load contacts are "plugged in" to stationary blades.

TEST POSITION
Partially withdrawn. Breaker is now entirely disconnected and safe for inspection.

FULLY WITHDRAWN
The complete unit rolls out of cabinet . . . just like an office file drawer . . . and is ready for thorough, easy inspection and maintenance.

Also available are electrically operated air circuit breakers. In their "test" position, auxiliary contacts remain in circuit to permit operation while line and load contacts are disconnected from stationary blades.

Roller-Smith

CORPORATION
ELECTRICAL SWITCHGEAR
BETHLEHEM, PENNSYLVANIA

"See A Qualified Electrical Contractor"

AVAILABLE THROUGH
AUTHORIZED ELECTRICAL WHOLESALERS

Sales Representatives in all principal cities.
CANADIAN FOREIGN

Kennecott's new adequate

and what it means to the Public Utility!

Few things are more important to Mr. and Mrs. Homeowner than the way their house is powered. He and she depend, as never before, upon a whole houseful of appliances. These electrical servants, in turn, must be fed plenty of power to operate smoothly at their full, built-in strength.

Yet, today, more than 80% of all the homes in America are underpowered! Not, as you well know, because *you* haven't the power to spare. But simply because the wiring in these homes just can't take it. Wires are too small, circuits too few to carry the needed load. It's a real, serious bottleneck in your business. You know it. So does Kennecott.

That's the reason for Kennecott's new national adequate wiring campaign in The Saturday Evening Post and This Week magazines. It's a drive that's bound to benefit *everyone* in the electrical industry. Because it sells the convenience, comfort and safety of full-powered wiring to millions of homeowners...teaches them how to recognize the symptoms of weak wiring and exactly what to do about them. Such education cannot help but build consumption of current, increase sales of appliances!

FREE! New Promotion Package!

Carry on the fight for better wiring where it will do you the most good — right in your own area! Ask us about FREE reprints and poster-sized blow-ups of powerful Kennecott ads, newspaper mats, and the exciting new book, "The ABC of Home Wiring." Address letter to Carl Lenz, President, Kennecott Copper Corporation, 161 East 42nd St., N. Y. 17, N. Y.

Kennecott
COPPER CORPORATION

Fabricating Subsidiaries:
CHASE BRASS & COPPER CO.
KENNECOTT WIRE & CABLE CO.

wiring campaign.....

CATALOGS • BULLETINS

● **PLUG-IN ELECTRONICS:** A 32-page bulletin (81554) presents circuit drawings and specifications on 29 plug-in units. Typical applications are also presented. EECO Production Co, 827 S. Vermont Ave, Los Angeles 5, Calif.

● **INFRARED BROODERS:** One- to six-lamp infrared brooders, with or without protective guards, manual or thermostatically operated, are covered in 4-page Bulletin 130-55. Bulletin 138-54 (2 pages) covers vaportite fixtures for 100 or 200 w lamps, for dairy establishments, showers, etc. Steber Manufacturing Co, Broadview, Ill.

● **SIGN LAMPS:** Primer of Sign Lighting Sources, 12 pages, covers sign lamps: incandescent, fluorescent, spotlight, floodlight, and blacklight. Sylvania Electric Products Inc, 1740 Broadway, New York 19, N. Y.

● **ANCHORS:** Expanding-type earth anchors are covered in condensed catalog and price sheet, No. 954, Sept 21, 1954. Pieper-Lilliard, Inc, 122 N. Kirkwood Rd, St. Louis 22, Mo.

● **CORE DRILLS:** Bulletin 21 (4 pages) describes core drills: 7.5, 11, and 16 hp; ⅞ to 2½-in. cores; to 400 ft depth. Acker Drill Co, 725 W. Lackawanna Ave, Scranton, Pa.

● **GROUTING:** A method of grouting claimed to be non-shrinking is covered in Form E-1c, 16 pages. Master Builders Co, 7016 Euclid Ave, Cleveland 3, Ohio.

● **TIMER:** Bulletin N-80, 4 pages, describes repeat-cycle timer for controlling on-off cycling of two independently-adjusted load circuits in machine and process control, 30 sec to 4 hrs. Automatic Temperature Control Co, Inc, 5212 Pulaski Ave, Philadelphia 44, Pa.

● **INDUSTRIAL LIGHTING:** Two 4-page booklets describe the CFI-25 and CFI-10 lamps which feature 25% and 10% indirect, or straight-up, light outputs, respectively. Day-Brite Lighting, Inc, 5411 Bulwer Ave, St. Louis 7, Mo.

● **STAINLESS STEEL ALLOYS:** Types, performance and application data for stainless steel and other metals with controlled porosity, are outlined in a 56-page brochure. Micro Metallic Corp, 30 Sea Cliff Ave, Glen Cove, N. Y.

● **WELDING ELECTRODES:** Several bulletins describe welding electrodes: Aluminum Electrodes for metal arc welding, Aluminum Welding Rods for oxy-acetylene welding, Aluminum Wire for inert arc welding (4 pages); Electrodes for Welding Cast Iron (4 pages); Gas Welding Rods (4 pages); Murex Stainless Steel Electrodes and Bare Wire (20 pages); Carbon and Low Alloy Steel Wire for Submerged Arc Welding (4 pages); Murex Aluminum Bronze and Phosphor Bronze Arc Welding Electrodes, Filler Rods and Coil Wire (20 pages); Murex Mild Steel and Low Alloy Arc Welding Electrodes (38 pages). Metal & Thermit Corp, 100 East 42nd St, New York 17, N. Y.

● **ALUMINUM PROTECTION:** A 4-page folder describes Alodine No. 1000 as a surface finish to protect aluminum. A flow sheet accompanies brief remarks on the Alodizing process. American Chemical Paint Co, Ambler, Pa.

● **VACUUM TUBES:** Seven electronic tubes are described in "Premium Quality, 10,000 Hour Tubes," a six-page illustrated folder giving characteristics and operating conditions of each. Amperex Electronic Corp, 230 Duffy Ave, Hicksville, L. I., N. Y.

● **VARIABLE SPEED DRIVE:** Four pages cover a new variable speed drive and gives enumerated advantages, text on how it works, a cut-away drawing showing its construction, and engineering drawings coded to show dimensions of the eight unit sizes. Ask for Bulletin K-100. Cleveland Worm & Gear Co, Speed Variator Div, 3269 East 80th St, Cleveland 4, Ohio

● **ELECTRICAL FITTINGS:** A 40-page catalog has six sections: Copper to Copper Fittings, Copper to Aluminum Fittings, Aluminum to Aluminum Fittings, Ground Rods and Accessories, Terminal Lugs, and Hoists & Miscellaneous. Jasper Blackburn Corp, 35 Madison St, St. Louis 6, Mo.

● **MAGNETIC CHECKING:** An 8-page booklet "Norelco Portaflux—New Portable Magnetic Particle Test Unit" describes a method for checking ferrous metal objects for surface discontinuities. North American Philips Co, Inc, 750 South Fulton Ave, Mount Vernon, N. Y.

● **DC OVERPOTENTIAL:** An improved method of testing insulation is described in this publication. Principles involved and bibliography of material on dc overpotential testing techniques are included. Sales Div, Beta Electric Corp, 333 East 103 St, New York 29, N. Y.

● **ETCHED CIRCUITS:** A leaflet describes elementary techniques used by the company in filling your specifications, and describing the company's engineering services that you may use in working up etched circuits. Hastings Instrument Co, Inc, Warwick, Va.

● **MOLYKOTE LUBRICANTS:** A two-page leaflet describes in technical detail the new Molykote Microsize lubricant. A graph helps illustrate how various-sized particles of molybdenum disulfide powders penetrate crevices of ground bearing surfaces. Ask for Bulletin 104. Alpha Corp, 65 Harvard Ave, Stamford, Conn.

● **SCREW-LOCK INSERT:** Four-page Bulletin 715-A contains selection tables, and line drawings showing proper installation in blind and through holes. Instructions are included covering use of the screw-lock insert. Heli-Coil Corp, Danbury, Conn.

● **ARMORED MOTORS:** A 20-page booklet (GEA-4654C) describes armored motors (dc types MD and MDP, 600 series), including performance and maintenance features of heavy-duty motors, and giving horsepower ratings and mechanical data. Illustrations show armored motor applications in steel, lumber, oil and construction industries. General Electric Co, Schenectady 5, N. Y.

● **HEAVY-DUTY MOTORS:** Bulletin F 3959-2 describes features and performance characteristics of Barcol heavy duty Type YAR motors used to drive pumps, fans and blowers, record changers, vending machines, and industrial controls. Barber-Colman Co, Rockford, Ill.

● **PYROMETERS:** Bulletin P1244 includes indicating pyrometers for service up to 4,000 F, indicating controllers with mercury switches or thyratron-operated relays, and portable indicating pyrometers. Bristol Co, Waterbury 20, Conn.

● **PLASTIC FILTERS:** Porous filter disks for anhydrous nitric acid, corrosives, hydraulic and lubricating oil, water, and organic solvents are covered in Releases Nos. T-103 and T-109. Porous Plastic Filter Co, Glen Cove, N. Y.

● **STORAGE BATTERIES:** Techniques for selecting batteries for stand-by power, emergency lighting and switchgear jobs are explained. Charging equipment and simplified maintenance methods also are covered in 20-page Bulletin 210. Dept. SP665, Exide Industrial Division, Electric Storage Battery Co, Box 8109, Philadelphia 1, Pa.

TECHNICAL LITERATURE

Al DRAFTING STANDARDS—Drafting Standards, Aluminum Extruded and Tubular Products, 2nd Edition (April 20, 1954) covers up to date advances in production and applications methods. Free on letterhead request. 56 pages. Aluminum Extruded Products Div, The Aluminum Association, 420 Lexington Ave, New York 17, N. Y.

NEMA—Publications available from National Electrical Manufacturers Association, 155 East 44th St, New York 17, N. Y., are:

● SG2-1954, "Standards Publication for High-voltage Fuses," a book concerning the rating, testing, application and manufacture of distribution cutouts, fuse links, power fuses and current-limiting resistors. Price $2.50.

● SG6-1954, "Standards Publication for Power Switching Equipment," deals with air switches, interrupter switches, bus supports, insulators, accessories, outdoor structures and pole-top frames. Price $2.75.

● TU2.1-1954, "Specifying a Geared Steam Turbine Synchronous Generator Unit," aims to assist purchasers in working up specifications for units rated 500 to 1,500 kw. Price $0.80.

● TU4.1-1954, "Specifying a Direct-Connected Steam Turbine Synchronous Generator Unit," covers purchase specifications for 60-cps, 3,600-rpm and 50-cps, 3,000-rpm machines rated 2,000 to 10,000 kw. Price $0.80.

● EW2-1954, "Standard for Arc-Welding Electrode Identification," has tables identifying arc-welding electrodes by use of various colors. This revised edition (Nov. 1954) supersedes the May 1954 issue. Price $0.75.

VACUUM-MELTED METALS—Technical Data Sheet HV-4 describes composition, uses and finishes for Carboloy Hevimet. Technical Bulletin VM-100, containing five pages of text and 11 pages of tables and graphs, describes 1570, an alloy designed for jet engine buckets, and M-252, also suitable for jet engine turbines. Carboloy, Box 237 Roosevelt Park P. O., Detroit 32, Mich.

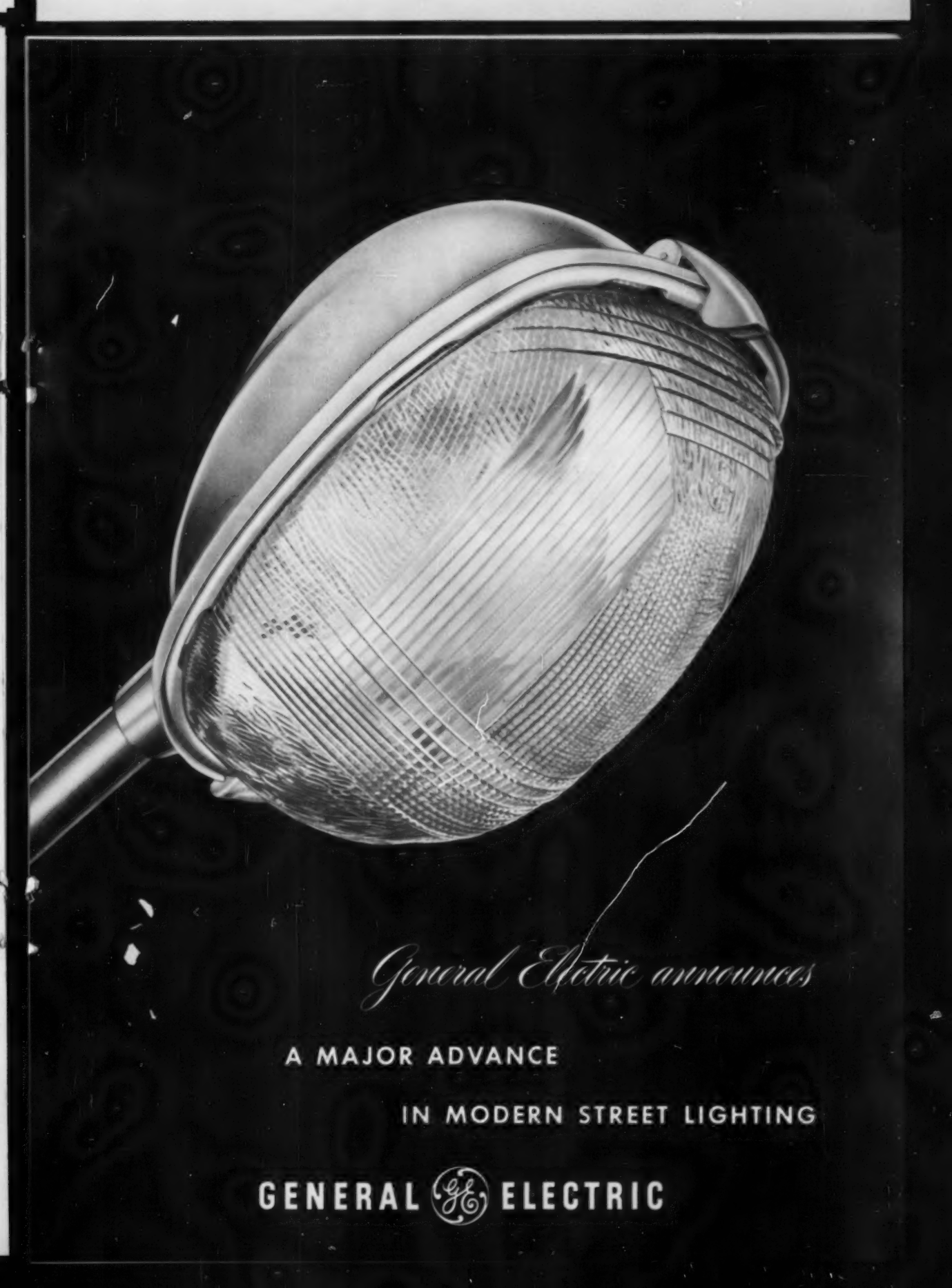
ALLOY WIRE—Engineering properties of Nickel Alloy Wire, Rod and Strip are presented in a wall chart which folds into a 8½ x 11-in. booklet. The chart measures 17 x 22 in, and is designed to help engineers select the right nickel alloy in wire, rod and strip form for specific products. Alloy Metal Wire Div, H. K. Porter Co, Inc, Prospect Park, Pa.

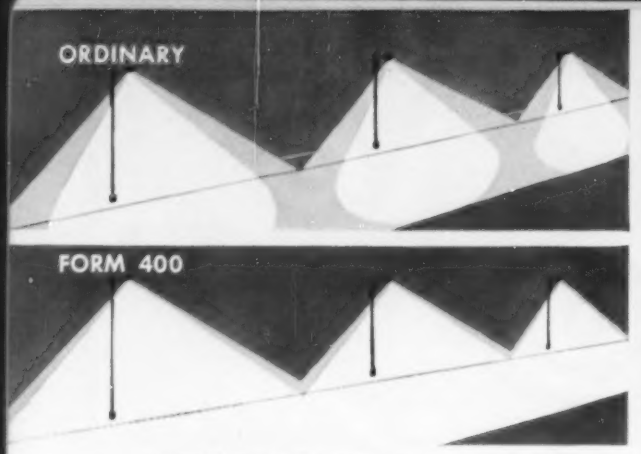
ALUMINUM CONDUCTOR—"Electrical Conductor Technical Manual" is a practical, comprehensive reference book on aluminum electrical conductor. The 190-page, illustrated book serves as a basic guide for engineering aluminum conductor installations.

The book provides data on the physical properties and electrical characteristics of all sizes and strandings; latest information on the application to overhead distribution systems; and basis for the calculation of all data accumulated, with the present specifications that govern the manufacture of Kaiser Aluminum electrical conductor. Basic engineering data enable the user to evaluate the essential design information and determine what is necessary for a specific job. About 72 pages of industry specifications are reproduced for ready reference.

Scope is sufficiently broad to interest all persons actively engaged in electric power distribution and transmission. The book is sectionalized, with a comprehensive table of contents and text and tables presented in easy-to-read type.

Free on company letterhead; otherwise, $2. Technical Editor, Kaiser Aluminum & Chemical Sales, Inc, 225 N. LaSalle St, Chicago 1, Ill.

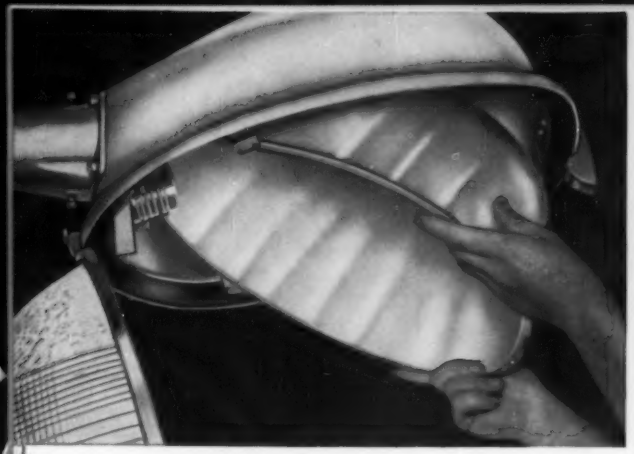

General Electric announces
A MAJOR ADVANCE
IN MODERN STREET LIGHTING
GENERAL ELECTRIC



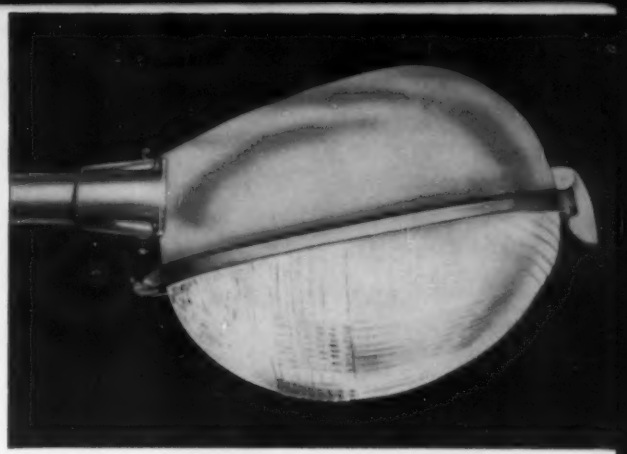
BETTER LIGHT CONTROL by the new Form 400 improves over-all visibility. Bright spots under the luminaire and dark areas near the edge of the beam are minimized to achieve greater uniformity of pavement brightness.

NEW EASE OF SERVICING of the new Form 400 speeds up maintenance and lowers costs. Glassware is hinged to provide full accessibility. Both glassware and the internal reflector are removable without the use of tools.

GENERAL ELECTRIC ANNOUNCES THE



GREATER FLEXIBILITY of the new Form 400 gives you either Type II or Type III distribution by changing snap-in reflectors. Five different mercury lamps may be used, and you can choose sockets for either multiple or series circuits.



NEW MODERN APPEARANCE of the Form 400 is highlighted by its distinctive new tilted design. The functional design of the Form 400 adds a handsome, progressive appearance to any community where it is installed.

New FORM 400 Luminaire

Better light control, greater flexibility, and easier servicing are features of new luminaire.

General Electric's handsome new Form 400 luminaire marks a major step forward in mercury street lighting. Optically, the Form 400 provides materially improved over-all visibility by combining unequalled uniformity of pavement brightness with a new high in utilization.

NEW EASE OF SERVICING—The glassware assembly of the new Form 400 is hinged to hang open a full 90° and thus provide complete accessibility for relamping and cleaning. The glassware will not come off accidentally, but it can be easily removed by lifting it off the "pick-off" hinge. Two stationary clamps and a spring clip firmly position the reflector, yet allow its removal without using tools.

GREATER FLEXIBILITY of the new Form 400 makes possible new operating economies. Snap-in reflectors for either Type II or Type III distribution are interchangeable. Since both use the same glassware, stocking of replacements is simplified. Five different mercury lamps can be used. Besides a conventional multiple socket for use on ballasted circuits, an entirely new series socket for Ballastless Mercury is also available.

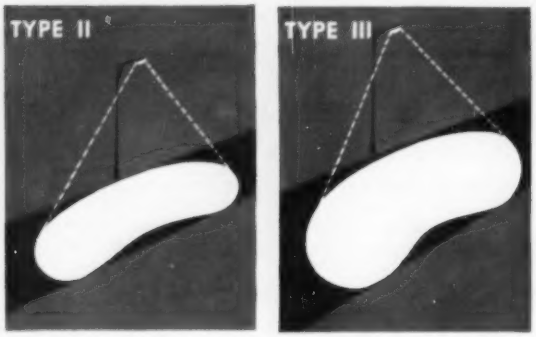
FULL INFORMATION on the new General Electric Form 400 mercury luminaire is told in an attractive new bulletin, GEA-6241. Contact your nearest General Electric Apparatus Sales Office, or write Section 452-152, Outdoor Lighting Dept., General Electric Co., West Lynn 3, Mass.

Progress Is Our Most Important Product

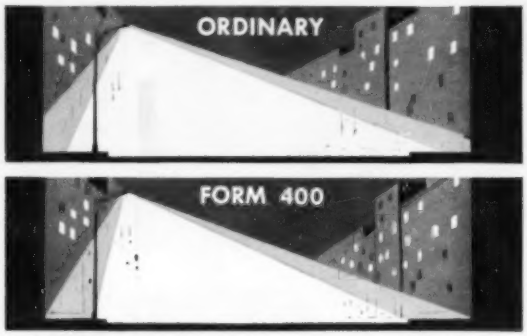
GENERAL ELECTRIC

New FORM 400 *Luminaire*

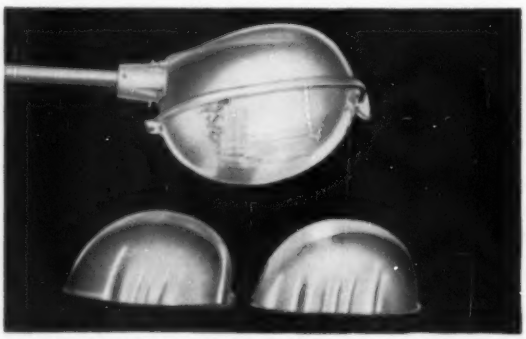
GIVES YOU NEW STREET LIGHTING ECONOMY



TWO DISTRIBUTION PATTERNS are available with the New General Electric Form 400 luminaire; Type II distribution for narrow streets, and Type III distribution for wider streets.

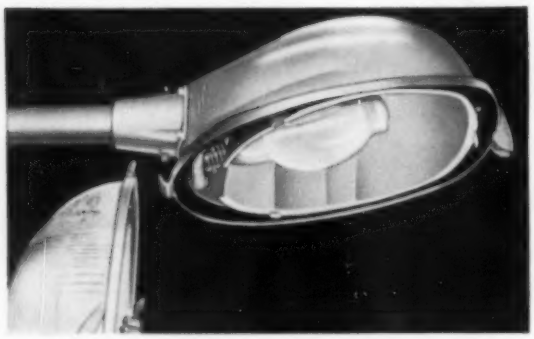


MORE LIGHT ON THE STREET—The unique tilted optical system of the new Form 400 luminaire concentrates more light on the street to achieve a new high in utilization.

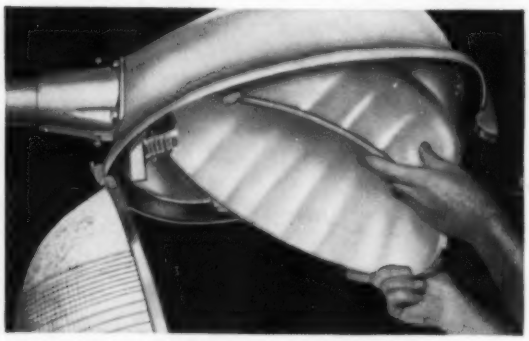


TWO REFLECTORS for the Form 400 give you a choice of Type II or Type III distribution using the same glassware. The snap-in reflectors are easily changed in the field.

FIVE LAMPS with ratings from 11,000 to 20,000 lumens may be used. A conventional multiple socket, and a new series socket for Ballastless Mercury circuits are available.



DETACHABLE GLASSWARE lifts off the special "pick-off" hinge for easy replacement. Glassware is released from its die-cast aluminum holder by removing a single screw.



NO TOOLS ARE NEEDED to take out or change reflectors. Two stationary clips on the sides and a spring clip at the end hold the snap-in reflector in correct position.

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Expansion Problems

(*Continued from page* 80)

higher initial expense in establishing a desirable pattern will reduce the expenditures of future additions and will generally result in a higher quality of performance for the whole system.

An ideal pattern will have the following functional attributes:

1. Permits heavy circuit loadings (above the surge impedance loading) without having a line outage result in—

a. Large voltage changes at bulk power stations.

b. Large overloads on those facilities remaining in service not normally designed for large overloads in the underlying subtransmission network.

2. Permits the logical addition of new generation and bulk substations to the transmission system at relatively low incremental expense.

3. Conveniently permits the addition of sectionalizing stations at any point as required by new high capacity interconnections or system stability considerations.

4. Permits relatively simple and reliable protective relaying on all parts of the system.

5. Relatively low initial cost.

Some Generalizations . . . This subject is difficult to generalize about other than to state broad functional requirements because the best pattern in a given situation depends a great deal on the geographical location and sizes of the generating stations and load areas. An understanding of the major factors with respect to patterns, however, can be obtained by comparing the four transmission patterns illustrated in Fig 12. A large generating station is assumed to be connected to an existing 115-kv network through a 230-kv transmission system feeding two bulk substations. Each of the patterns (Cases A to D) is graded in Table I on the basis of the previously listed attributes of an ideal pattern.

Many more points of comparison could be drawn with regard to patterns. But, as appears in Table I, the patterns represented by Cases A and B appear to approach the ideal more closely than Cases B or C. The principal difficulty encountered with Case A is the initial high cost usually involved. Case D is a compromise.

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Also available without mounting hole for use with gun.

patent pending

Made of heavier materials! Has exclusive inverted rib, that provides more strength at the bend of clip . . . and, of course, adds the benefits of famous "Snap On" feature!

In stock in Zinc-Plated Steel for ½"—¾"—1" and 1¼" Thin Wall or Rigid Conduit. (Hot Dipped Galvanized may be obtained on order) Can be substituted for malleable clips.

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G. F. FOLEY

Foley Named Vice President

George F. Foley has been elected a vice president of Florida Power Corp. The newly elected official will also continue to serve as assistant secretary and assistant treasurer, positions he has filled during the past nine years.

A 1924 graduate of Brown University, Foley worked in New York with Hornblower & Weeks, investment bankers, for three years following graduation. After joining Utility Management Co in 1927, he filled executive positions in many of its associated companies. He formerly was vice president of the Kentucky-Tennessee Light & Power Co; and secretary-treasurer of the Louisiana Public Utilities Co, Texas General Utilities Co, Tri-City Utilities Co, and Owensboro (Ky.) Gas Co.

Baldwin-Lima-Hamilton's Top Level Appointments

OLIVER DeG VANDERBILT

Baldwin-Lima-Hamilton Corp has revealed these appointments and promotions: McClure Kelley, president of Austin-Western Co, Aurora, Ill., a B-L-H subsidiary, and general manager of B-L-H's Construction Machinery Division, was promoted to executive vice president of B-L-H. Oliver DeG Vanderbilt, former president of Taylor-Wharton Iron & Steel Co, was made vice president of all commercial activities.

B-L-H Pres Marvin W. Smith was named executive committee chairman. Ralph K. Stiles was advanced from executive vice president of A-W to president. Henry F. Barnhart, vice president of B-L-H's Lima Division, was elevated from assistant general manager to general manager of the Construction Machinery Division. New director of sales for that division is Henry F. Lockhart, manager of A-W's Rochelle Plant.

McCLURE KELLEY

Kerite Co Elects Rudd President

Theodore O. Rudd has been elected president of Kerite Co. Rudd, formerly a vice president, succeeds C. R. R. Harris, who was named chairman of the board and chief executive officer. In his new post as chairman, Harris will continue to serve the firm as treasurer.

Rudd began his career with Kerite in 1926 as a sales engineer. He was made a department manager in 1941, a vice president in 1945, and a director in 1946. His election to the post of president became effective Jan. 1.

Prior to joining Kerite, Rudd was employed by Philadelphia Electric Co from June, 1924, to January, 1926. He served most of that time as a cadet engineer.

Born in Media, Pa., Rudd was graduated from Yale University's Sheffield Scientific School in 1924 with a B.S. degree. While still attending college, he spent one summer with Public Service Electric & Gas Co of Newark, N. J.

T. O. RUDD

What's New in Steel Service

Again in 1955, as in every year since 1842, Ryerson is setting the steel-service pace. Many advances in our ability to serve you have been made in recent months—many more are immediately ahead. Briefly, here is what you can expect:

EXPANDED STOCKS—Amazing new leaded alloys in three carbon ranges—carbon steel plates produced to an "easy-welding and forming" specification—304L and 316L stainless plates and sheets for superior welding characteristics—type 430 stainless sheets for those who want an alternate to higher priced 18-8 stainless. These are a few recent additions and further stock expansion is already under way.

NEW QUALITY SAFEGUARDS—Steel you order from Ryerson now protected by a whole new set of quality control standards—tighter than any thought possible before. As evidence of uniform high quality we can furnish a certificate of analysis or a mechanical properties report for every pound of steel we ship.

STEPPED-UP SERVICE—On 92 to 98% of the regular orders we receive, steel is cut and shipped the same or following day. With two new plants getting into operation, and with facilities enlarged and modernized from coast to coast, we'll do even better in the weeks ahead.

So here's our steel-service pledge to you—an even wider selection of steels, dependable high quality, delivery where you want it—when you want it—now and throughout 1955.

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Oklahoma G&E Reassigns Three

Oklahoma Gas & Electric Co has moved three employees into higher managerial assignments as the result of the retirement of Bernard J. Braheney, Central Division manager.

Emil Wyatt, district manager, at Ada, moved to Sapulpa to become Central Division manager, where he will supervise the utility's operation in a 24-town area. Wyatt's successor is Garland P. Middaugh, formerly manager at Alva. Norborne C. Auld goes from Western Division operating superintendent over to Alva as district manager.

E. WYATT

S. L. HILYARD T. W. SCHROEDER

Hilyard, Schroeder Advanced

Stuart L. Hilyard has been named assistant vice president of Illinois Power Co to head up a newly created department charged with following the developments in generation of electric energy by the use of atomic energy. Theodore W. Schroeder, who joined the utility in 1953 as assistant chief electrical engineer, succeeds Hilyard as chief electrical engineer.

PERSONAL BRIEFS

Sidney O. Evans, superintendent of the extrusion department, has been appointed to the newly created position of manager of tubing operations of Babcock & Wilcox Co's Tubular Products Division plant in Beaver Falls, Pa. **David A. Edgecombe,** who joined B&W in 1947, replaces Evans in the superintendent's post . . . **Deskin O. Bergey,** division sales manager in Portland for Pacific Power & Light Co, has been assigned to the new position of district manager for the Coos Bay area. He relieves **J. W. Asplund,** who has retired after 38 years with PP&L . . . Allis-Chalmers Manufacturing Co has revealed that **Martin L. Carson,** general manager of its Terre Haute Works, was placed on a special assignment in the office of J. L. Singleton, vice president in charge of General Machinery Division. **L. W. Long,** general manager of the Boston Works, succeeds Carson. Long is succeeded by **John F. Chipman,** assistant chief engineer, switchgear department . . . **Phil O'Connell,** assistant to the advertising manager of Potomac Edison Co since 1951, has been named advertising manager to succeed **C. D. Lyon,** recently appointed promotional manager . . . Line Material Co has announced that **Richard C. Kirk,** manager of Kyle products sales, was advanced to chief engineer, Kyle Products Plant. He succeeds **Anthony F. Van Ryan,** who will continue to serve L-M as a new product consultant. **Frank W. McStay** was elevated from apparatus engineer in L-M's North Central Division to manager of Kyle Products sales . . . Anchor Manufacturing Co promoted **F. E. Davis** from engineering vice president to executive vice president. **R. MacKay,** assistant to the president, was made New England sales manager and **J. C. Purrell** goes from production manager to assistant works manager . . . **Edward R. Trapnell,** special assistant to the general manager of the Atomic Energy Commission, has left that agency to join Bozell & Jacobs, Inc. He will work out of its Washington office . . . **Robert C. Langford,** assistant to the vice president in charge of engineering for Weston Electrical Instrument Corp, has been appointed assistant chief engineer . . . **John L. Burgan** has retired as director of rural development for New York State Electric & Gas Corp after completing more than 25 years' service. **Lyman H. Hammond,** manager of domestic and farm sales, succeeds Burgan.

Army Engineer Changes

Army Corps of Engineers has announced these changes: Col Robert J. Fleming, Jr, district engineer at Philadelphia, replaces Col Richard W. Pearson, New England Division engineer at Boston, who is retiring because of ill health. Col Allen F. Clark, Jr, Memphis District engineer, replaces Fleming at Philadelphia, and Col E. B. Downing, assistant to Memphis District engineer, succeeds Clark at Memphis.

OBITUARY

Paul Wayne Lee, 78, general counsel for Public Service Co of Colorado, died last month in Colorado Springs. He was formerly a member of the board of directors of that utility.

J. Elmer Brock, 72, president of the Wyoming Natural Resources Board, died Dec. 6 at Buffalo, Wyo., where he had gone to attend a board meeting to discuss proposed Lake DeSmet power project by Reynolds Metals Co.

Otto Kluegel, 56, president of the board of directors of the Glidden (Iowa) Rural Electric Cooperative, died Dec. 10 at Carroll, Iowa. Kluegel, one of project organizers, had been a board member since 1939.

Meetings Calendar

Week of Jan. 9-15

ELECTRICAL EQUIPMENT REPRESENTATIVES ASSOCIATION
Breakers, Palm Beach, Fla., Jan. 10-12.

NATIONAL ASSOCIATION OF ELECTRICAL DISTRIBUTORS
Appliance Division, Conrad Hilton Hotel, Chicago, Jan. 12-14.

NATIONAL ASSOCIATION OF PURCHASING AGENTS
Third Region, Jefferson Hotel, St. Louis, Jan. 13-14.

PUBLIC INFORMATION PROGRAM
Workshop Conference Committee, Blackstone Hotel, Chicago, Jan. 14.

Week of Jan. 16-22

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
High Frequency Measurement Conference, Hotel Statler, Washington, Jan. 17-19.

EDISON ELECTRIC INSTITUTE
Industrial Relations Committee, EEI Headquarters, New York, Jan. 20.

***SOUTHEASTERN ELECTRIC EXCHANGE**
Personnel Administration Section, Floridan Hotel, Tampa, Fla., Jan. 20-21.

PUBLIC INFORMATION PROGRAM
Mid-Atlantic Region, Seaview Country Club, Absecon, N. J., Jan. 21.

Week of Jan. 23-29

DOBLE ENGINEERING CONFERENCE
22nd Annual Meeting, Sheraton Plaza Hotel, Boston, Jan. 24-28.

CANADIAN ELECTRICAL ASSOCIATION
Eastern Zone, All Divisions, Sheraton-Brock Hotel, Niagara Falls, Ont., Jan. 25-28.

PACIFIC COAST ELECTRICAL ASSOCIATION
Business Development Section, Hotel California, Fresno, Calif., Jan. 27-28.

Week of Jan. 30-Feb. 5

***EDISON ELECTRIC INSTITUTE**
Power and Heating Committee, Atlanta Biltmore Hotel, Atlanta, Ga., Jan. 31-Feb. 1; Prime Movers Committee, Grand Hotel, Mobile, Ala., Jan. 31-Feb. 1; Home Service Committee, Washington, D. C., Feb. 4-5.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
Winter General Meeting, Hotel Statler, New York, Jan. 31-Feb. 4.

***AMERICAN SOCIETY FOR TESTING MATERIALS**
Annual Committee Week, Netherland Plaza Hotel, Cincinnati, Ohio, Jan. 31-Feb. 4.

MISSOURI VALLEY ELECTRIC ASSOCIATION
Industrial-Commercial Sales Conference, President Hotel, Kansas City, Feb. 3-4.

*Additions this week.

NPPA Redrafting Columbia Bill

Proposed measure is being reworded to limit scope to geographic limits of four principal states of the region

Revision of the Columbia River Development Corp proposal of Northwest Public Power Association will delay presentation to Congress while the bill is reworded limiting its scope to geographic limits of the four principal states of the region and provision is made for eventual election or home state appointment of four directors.

Backers of the legislative plan, which NPPA began formulating last spring and hoped to have ready for Congress in January, now expect to present the final draft to the Northwest delegation sometime in March, seek preliminary hearings during the summer and perhaps achieve public hearings under Congressional committee sanction by fall. The bill could then be ready for Congressional action by 1956.

Public Power Groups Approve . . . Membership approval of the semi-final draft of the proposed bill was voted in mid-December in Spokane, Wash., at the conclusion of three days of separate action on the corporation plan by the association's legislative committee, the board of trustees and finally the members who had been called into special session. Other public power organizations, REA's and PUD's of Washington and Oregon in particular, have gone on record expressing interest in the success of the bill and endorsing "major policy provisions." But NPPA Executive Secretary Gus Norwood reports the proposed legislation continues to be an evolving formula for establishing an agency to acquire the Bonneville Power Administration's transmission system, the federal power plants on the Columbia River and to plan, build and manage new facilities and to acquire existing and future electric generating plant under broad authority of a federal corporation.

Geographic Limitations . . . The move to limit boundaries to the geographic limits of Washington, Oregon, Idaho and Montana is rooted in a belief the basin approach—which involves political support in Wyoming, Nevada and Utah although a mere 5% of the basin area—is too cumbersome to achieve representation for these fringe states.

Four-state support for the corporation might prove advantageous in attracting low interest investment capital for revenue bonds. A primary objective in the corporation planning has been to achieve the lowest possible rate of interest for the huge capital investment NPPA forecasts will be necessary to develop adequate energy supply for the region's electric utilities.

Relationship of Montana . . . A significant development affecting Montana and its relation to the Columbia plan and the Missouri Basin Commission was the request of Montana members that eastern Montana be included in the scope of the Columbia proposal. Streams of western Montana flow into the Columbia; those of eastern Montana into the Missouri. The Montana members noted the relatively recent shifting of its economy from ties with the Midwest to the West Coast and cited the fact that western Montana streams represent 85% of the hydroelectric potential of the state.

Splitting off the basin fringe areas of Nevada, Utah and Wyoming and addition of eastern Montana may pose new complications in the practical problems of political and public support. Opposition to the NPPA bill may be directed at the political, and particularly the initial federal domination of the policy board. Some private utility spokesmen have declared the bill is merely "another CVA by another name." But until the association's final draft is publicized there is not likely to be open or vocal opposition. "The Oregonian," for example, has been editorially championing the cause of a regional corporation for several years. The private utilities would prefer, however, that any Columbia agency which would handle generation and transmission on a combined system basis be controlled by the local distribution bodies, whether public or private.

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ADVISORS TO UTILITIES
Financing—Rate of Return
30 Vesey Street, New York 7, N. Y.

PROFESSIONAL SERVICES

(Continued from preceding page)

SANDERSON & PORTER

Engineers and Constructors Reports and Surveys

New York — New York

SARGENT & LUNDY

ENGINEERS

140 South Dearborn St.

Chicago, Ill.

F. W. SCHEIDENHELM

Consulting Engineer

Hydraulic Engineering, Hydro-electric Development, Water Supply, Flood Control. Engineering Problems relating to Water Rights and Water Power Law. Appraisals.

80 Church Street, New York 7, N. Y.

F. A. TUCKER, INC.

Contractors—Engineers

specialize in

Distribution - Transmission - Telephone lines - Maintenance - Roads - Bridges Dams

Main Office—88½ Center Street, Rutland, Vt.
Branch Office—110 East 3rd St., Charlotte, N. C.

UTILITIES LINE CONSTRUCTION COMPANY, INC.

Construction and Maintenance

Transmission - Distribution
Electric and Telephone Lines
Consultants

606 York Road — Jenkintown, Pa.

THE J. G. WHITE ENGINEERING CORPORATION

Design • Construction • Reports • Appraisals

80 Broad Street, New York 4

"By reason of special training, wide experience and tested ability, coupled with professional integrity, the consulting engineer brings to his client detached engineering and economic advice that rises above local limitations and encompasses the availability of all modern developments in the fields where he practices as an expert. His services, which do not replace but supplement and broaden those of regularly employed personnel, are justified on the ground that he saves his client more than he costs him."

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SEARCHLIGHT SECTION
(Classified Advertising)
H. E. Hilty, Mgr.

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CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:

$1.50 a line, minimum 3 lines.
To figure advance payment count 5 average words as a line.

INDIVIDUAL EMPLOYMENT WANTED undisplayed advertising rate is one-half of above rate, payable in advance.

PROPOSALS, $1.50 a line an insertion

INFORMATION:

BOX NUMBERS count as 1 line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals.)

EQUIPMENT WANTED OR FOR SALE Advertisements acceptable only in Displayed Style.

DISPLAYED RATE:

The advertising rate is $14.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. E. W.

SEND NEW ADVERTISEMENTS TO: 330 W. 42 ST., N. Y. 36, N. Y. for January 24th issue closing January 14th

OUTSTANDING OPPORTUNITY

Established, growing manufacturer of line construction material sold through representatives seeks truly outstanding man to assume direction all sales functions.

Experience in outside construction sales and national user and distributor contacts are desirable. Age under 45, excellent health, proved performance record, travel at least half of time are requirements. Opportunity to acquire substantial stock option available upon demonstrated performance.

Replies (in complete confidence) should include full history and recent snapshot if available.

If you are doubtful reply blind with general record to Classified Advertising Div., Electrical World, who will apply a blind key number to your application and arrange to forward further correspondence to you.

P-4766, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

ELECTRICAL ENGINEERS

A well-known Eastern oil company has several openings on the staff of its Engineering & Construction Dept. for graduate Electrical Engineers experienced in design, construction, installation, performance and application of electrical power generating and consuming equipment and related distribution systems and auxiliary equipment. Assignments will include such diversified items as refinery units and equipment, service stations, marine terminals, office buildings, bulk plants and pipe lines. If you are looking for a position that affords interesting work and advancement opportunities, send resume and salary requirements. Replies will be held in strict confidence.

E. T. ADDISON
P. O. Box 7238, Philadelphia 1, Pa.

WANTED

Unusual opportunity for salesman, experienced in calling on utilities to head up a well established North Atlantic states territory for eastern manufacturer of Pole line hardware specialities. Current earnings five figures. Expenses. Incumbent retiring because of exigencies beyond his control.

SW-5077, Electrical World
330 W. 42 St., New York 36, N. Y.

FOREIGN SERVICE RELAY TECHNICIANS

Qualified Journeyman Electrician with minimum 2 years' experience as a Relay Technician investigating and correcting power line circuit troubles caused by relay failures.

UTILITIES OPERATORS

Minimum 4 years' Journeymen experience in Power Plant and Utilities embracing air conditioning, refrigeration, water and sewage disposal—Municipal Sewage License very desirable.
Write giving full particulars regarding personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 101
ARABIAN AMERICAN OIL COMPANY
505 Park Avenue
New York 22, N. Y.

WANTED DISTRIBUTION ENGINEER

To head up this activity on a system basis with a rapidly growing medium-size midwest utility company. Must be a graduate engineer with considerable experience in distribution, planning and construction. Send resume of experience and qualifications to

P-5045, Electrical World
330 West 42nd Street, New York 36, New York

MANUFACTURER'S REPRESENTATIVE

To represent New York manufacturer for heavy duty cast copper bus and ground connectors. Also specialty fittings for substations, power distribution systems and industrial plants. Must have contacts power companies and consulting firms. Advise regarding non-conflicting lines now handled and territory covered. All replies strictly confidential.

RW-4776, Electrical World
330 W. 42 St., New York 36, N. Y.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

DISTRIBUTION ENGINEERS — Competent graduate electrical engineers with approximately 10 years experience design, operation and maintenance of distribution facilities required by rapidly growing utility desirable location South America. Portuguese or Spanish useful—not required to start. Reply stating age, education, experience, personal particulars and minimum salary expected. P-5069, Electrical World.

DISTRIBUTION ENGINEERS—Graduate Electrical engineers — senior approximately 10 years field experience with operating utility company. Junior at least 3 years experience. Permanent position long established consulting organization New York. Some travel Latin American necessary in future. Knowledge of Spanish or Portuguese useful. Salary commensurate with experience. Reply stating age, education, experience, personal particulars and minimum salary expected. P-5070, Electrical World.

WANTED — EXPERIENCED Electrification advisor for Coop with 1500 miles, 7400 members, distributing 36,000,000Kwh per year. Excellent opportunity for right man. Northwestern Rural Electric Cooperative Association, Inc. Cambridge Springs, Pa. Wm. C. Wenner, Manager.

SELLING OPPORTUNITY OFFERED

WANTED: AGGRESSIVE representatives for new revolutionary, aluminum UL-approved, patented Romex connector. Easiest and quickest of all to install. No special tools. Priced right. More items to follow. Top commissions. Denman Products Co., 210-A Beits Block, Ravenna, Ohio.

EMPLOYMENT SERVICES

SALARIED PERSONNEL, $3,000-$25,000. This confidential service established 1920, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. L, 241 Orange St., New Haven, Conn.

POSITION WANTED

OPPORTUNITY — CHALLENGE — Leading manufacturer of electric power connectors, clamps, line fittings and accessories seeks sales manager to head up distribution equipment division. E. E. or M. E. degree required. Responsible for administering national sales promotion program including responsibility for profit, new product development, advertising, and field education. Age 35 to 45. Knowledge of electric utility practices and experience in selling this class of customer essential. Our sales personnel know of this ad. Send resume, including photograph to PW-5017, Electrical World.

PERIODICALS

A.I.E.E. transactions back-volumes wanted to buy for cash. Ashley 24 E. 21, N.Y.C. (10).

U. S. Government

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-4331), will be received at Denver, Colorado, until March 1, 1955, for furnishing one (1) metal-clad, double-ended type, 13,200- to 480- and 41,800- to 480-volt, 1,500-kva, outdoor unit substation for Fargo Substation, Missouri River Basin Project, North Dakota. Delivery is desired within 300 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver, Colorado. W. A. Dexheimer, Commissioner.

COMING

January 24, 1955

51st ANNUAL STATISTICAL ISSUE

To the reader, (over 25,000) it is an indispensable working tool, a compendium of fact, a basic reference, the "answer man" to a thousand questions.

To the advertiser, it delivers all the benefits and by-products of a peak reader interest, high traffic, long use advertising vehicle. You benefit from the day it is pulled out of its wrapper until the following January when World's newest Annual Statistical Issue arrives.

Place your advertisement where it will speak for you all year long.

Closing Date—January 14, 1955 for Classified Advertisements.

Reserve Your Space Today.

Classified Advertising Division
ELECTRICAL WORLD
330 W. 42 St. N. Y. 36, N. Y.

TRANSFORMERS

FOR SALE

3—1000 KVA Mol. 13200-2400/4160Y
3—1000 KVA Mol. 11500-2400/4160Y
3— 833 KVA G-E 35000—480
3— 500 KVA G-E 26400—240/480
3— 333 KVA W-H 38000-7200/13470Y
3— 333 KVA G-E 33000-2300/4000Y/6600/-11850Y
3— 333 KVA G-E 33000-2300/4000Y
3— 333 KVA Mol 7200/12470Y-2300/4160Y
9— 200 KVA W-H 13200-230/460
3— 150 KVA G-E 19050/33000Y-2540/4000Y
3— 150 KVA G-E 7200/12470Y-240/480
3— 100 KVA G-E 33000-6900/11850Y

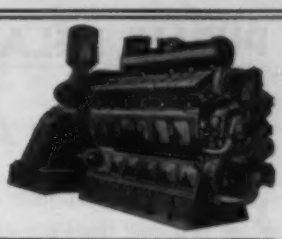
Many other items in stock

TRANSFORMERS WANTED

Reliable rewind and repair service on all makes of transformers

THE ELECTRIC SERVICE CO.
Cincinnati 27, Ohio
40 Years Dependable Service

DIESEL POWER



IMMEDIATE SHIPMENT
• PURCHASE OR RENTAL
UNIT CAPACITIES—10 TO 2475 KVA
A.C.—50 AND 60 CYCLES
• ALSO D.C. UNITS

A PARTIAL LISTING OF OUR INVENTORY

KW	Make	Model	HP	RPM	KW	Make	Model	HP	RPM
1180	Worthington	SEH-8	1695	360	320	Superior	6SB-6	440	450
1136	Fairbanks Morse	38D	1600	720	300	General Motors	8-268A	440	1200
1100	General Motors	16-278A	1800	720	200	Clark	GD-6	275	720
750	General Motors	12-567	1080	720	200	General Motors	6-268A	300	900
700	Worthington	EE-6	1000	327	175	General Motors	12-71	275	1800
600	General Motors	12-567	900	600	150	Worthington	OO-4	225	440
500	General Motors	8-567	720	720	150	Buckeye	80	240	600
400	Alco	6-12½x13T	700	600	148	Fairbanks Morse	32E14	220	300
350	Baldwin	VO-8	510	450	100	General Motors	4-268A	150	1200
320	Enterprise	DSG-6	460	450	60	General Motors	6-71	90	1200

A. G. SCHOONMAKER COMPANY, INC.

DIESEL DIVISION, 50 CHURCH ST., NEW YORK 7, N. Y.

REBUILT AND NEW

GUARANTEED MOTORS

M.G. SETS • GENERATORS

Hoists • Compressors • Transformers
Units of Every Size and Description

MOTOR GENERATOR SETS

K. W.	MAKE	A. C.	D. C.
1000 (3u)	Westg.	11000	127/275
500	Westg.	2300	137/275
500	Westg.	2300	275
400	A.C.	2300	120/240
250	Westg.	2300	125/250
200	G.E.	2300	250
200	Westg.	4160	250
200	Ridgeway	2300	250
170	G.E.	440	135
150	G.E.	2300	125/250
150	G.E.	4000	250
150	A.C.	2300	275
150	Westg.	2300	125/250
150	G.E.	440	275
100	G.E.	2300	250

TRANSFORMERS

KVA	MAKE	PRI. V.	SEC. V.
250 (3)	Westg. (oil)	2400/4160	480/240
150 (3)	Chi. Elec. (dry)	2300	115/230
100 (3)	Jeffery (dry)	2400	130/240
75 (3)	G.E. (prt)	2400Δ	120/208
50 (3)	Westg. (oil)	7200	120/240

WE'LL SELL, BUY OR TRADE
PHONE CANAL 6-2900

CHICAGO *Electric Co*

1324 W. CERMAK ROAD
CHICAGO 8, ILL.

RE-NU-BUILT
GUARANTEED

ELECTRIC POWER EQUIPMENT

MOTOR GENERATOR SETS

3 ph., 60 cy.

Qu.	KW	Make	Speed	DC Volts	DC Volts
1	3000 3U	G.E.	514	600	4000/13200
2	2000/2400	G.E.	450	250/300-2300/4600
2	2000	G.E.	514	600	6600/13200
1	2000	G.E.	600	666 25 cy.	11000
2	2000	G.E.	450	600	2300/4600
1	1500	C.W.	514	115	4000/13800
1	1500	G.E.	720	600	13200
1	1000	G.E.	900	260	4100/6600
2	1000	G.E.	720	600	2300/4600
2	750	G.E.	720	275	2300/4600
1	500	Whse.	1200	125/250	2300
1	400	Whse.	900	250	440
1	400	G.E.	720	125	2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Condensing—425 lbs—750° F.T.T.—Surface Condenser 3/60/2300-4000 v with exciter
1	1000	G.E.	Non-Cond—190 lbs-2400-3-60
1	1000	Moore	Condensing — Extraction—190 lbs., 2400-3-60—Surface Cond
1	750	G.E.	Condensing—365 lbs., 440-3-60 Built 1944
1	500	Moore	Non-Cond—150/200 lbs., 5/35 lbs. B.P., 480-3-60 DR. Cran. Exciter.
1	300	G.E.	Non-Cond—150/175 lbs., 5/10 lbs. B. P. 480-3-60

FREQUENCY CHANGERS

Qu.	Kva	Make	Cycles	Voltages
1	13800	Whse.	60/25	13200 x 13200
1	3750	G.E.	60/25	4150/2400 x 2400/4160
1	3125	G.E.	25/60	4150/2400 x 2400/4160
1	2500	G.E.	25/62½	2300 x 4160
1	1250	G.E.	25/58.3	4600 x 2300
1	625	A.C.	25/60	11000 x 2300

TRANSFORMERS—60 Cycle

KVA	Make	Type	Ph	Voltages
1	5000	Whse.	OISC	3	23000x26400/12200
1	2500	Whse.	OISC	3	26400/13200 x 480
2	2000	G.E.	HVDDJ	1	69000 x 13800
2	667	G.E.	HD	1	13800 x 230x
1	1250	G.E.	HVDDJ		6600/440
1	1000	G.E.	HVDDJ	1	2300/480

BELYEA COMPANY, INC.

51 Howell Street, Jersey City 6, N. Y.

SUBSTATIONS EQUIPMENT

TRANSFORMERS

QU.	KVA	MFR.	VOLTAGE
1	10000	A. C.	66000—23000, 3 ph.
1	3750	West.	69000—14400, 3 ph.
4	2500	Mol.	66000—13800
3	800	Kuhl.	66000—480
6	500	West.	69000—6900
3	400	G. E.	66000/33000—2300/4160
3	333	Stand.	69000/34500—7200/12470 Y
3	200	Pitts.	66000—2300
3	150	Wag.	44000—6900
8	1250	A. C.	44000/11500—460
4	150	West.	44000/33000—2300/6900
3	75	West.	44000—7200/12470 Y
3	5000	G. E.	38100/66000—6600
1	3750	Penna.	38050/65865 Y—13800, 3 ph.
3	3333	G. E.	38100/66000 Y—33000
4	3125	Mol.	29900/66000 Y—26600/66000 Y
2	2000	Mol.	38100/66000 Y—13800
3	3333	G. E.	33000/11000—2400/7200
4	333	G. E.	34500—13800, 23900 Y
3	200	A. C.	34500—2400/7200/12470 Y
1	3000	G. E.	33000—6900/2300, 3 ph.
2	3000	Stand.	33000—6160, 3 ph.
4	3333	G. E.	33000—2400/4800
3	75	Wag.	33000—240/480
3	1250	G. E.	25400/13200—2400
4	1500	A. C.	25400/44000 Y—6900/13800
4	450	A. C.	25410/44000 Y—13200/23000
3	100	G. E.	22900—7200/12470 Y
1	2000	G. E.	13800—2300, 3 ph.
1	660	Stand.	13200—2300, 3 ph.
1	450	Penna.	13200—2400, 3 ph. ASKAREL
6	200	G. E.	13200—230/460
6	167	G. E.	7200/12470 Y—2400
3	125	A. C.	6900—2300
3	37½	G. E.	6900—230/460
4	150	G. E.	4800/2400—240/120
2	100	G. E.	4800/2400—240/480
1	1500	G. E.	4160—480, 3 ph.
3	833	G. E.	4160/6160 Y—460
3	250	G. E.	2300/4000 Y—115/230
3	200	West.	2400—240/480
3	150	West.	2400—230/115
1	100	G. E.	2300—575, 3 ph.
6	50	West.	2400—114/228 DRY TYPE
1	50	G. E.	2400/4160 Y—240/480, 3 ph.

ALSO:—FREQUENCY CHANGERS
MOTOR GENERATOR SETS
SYNCH. CONDENSERS
OIL CIRCUIT BREAKERS
FEEDER REGULATORS, etc.

BREW, WOLTMAN & CO., INC.

52 Church St. New York 7, New York

MOTORS · GENERATORS TRANSFORMERS

NEW • REBUILT
WORLD'S LARGEST INVENTORY
ELECTRIC EQUIPMENT CO.
PHONE STATION COLLECT GL 6783
P.O. BOX 51 ROCHESTER 1, NEW YORK

"Opportunity" Advertising
Think
"SEARCHLIGHT"
First

WANTED

DIESEL ELECTRIC UNITS

Needed Used Diesel Electric Units from 2500 K.W. to 5000 K.W. Sea level rating to generate at 2400/4160 volts three phase-60 cycles, history, prices, place & time of delivery.

Post Office Box 1324
New York 8, New York

ELECTRICAL WIRE AND CABLE

—Your Best Source—
- for every industrial and power application
- Odd lengths—long and short—reasonably priced
- **LARGEST STOCK IN MIDWEST**

Let us quote on requirements—send your inquiries
We'll also keep your Surplus

Branch Offices:
Newton— Yukon 8547 Los Angeles— Allgeier 3-5148

UNIVERSAL Wire and Cable Co.
2062 N. Clybourn Ave., Chicago 14, Ill.
EAngelo 7-4777 Cable: UNIWIRE

Are There Any Questions?

Industry pamphlets offer answers to frequently-asked questions ranging from atomic energy to "troublesome terms"

Edison Electric Institute's new edition of "I Want to Know About the Electrical Industry" heads the list of informational pamphlets recently issued by industry sources. Three others released in recent weeks give background on a number of subjects that have attracted wide public attention during the past year. All are available for direct distribution to the public or they may be secured to aid individual utilities answer the queries that come to them.

"I Want to Know . . ." The EEI booklet is presented in the form of 28 questions frequently asked about the electric industry. The recent edition is the seventh in a series begun in 1948. A handy reference to industry statistics, the booklet has proved its value for those interested in reading and writing about the industry.

Drawing on several basic sources including EEI's annual statistical bulletin and various governmental publications, the pamphlet answers such questions as "How does the U. S. rank in world production of electricity?" "How much fuel is used in electricity production?" and "What about producing electricity from atomic energy?"

For the neophyte, the EEI booklet also offers an easy explanation of the difference between kilowatts and kilowatthours.

AEC-Dixon-Yates Contract . . . National Association of Electric Companies has compiled a history of the much-discussed Dixon-Yates contract in a four-page paper called "Power for Atomic Development." The paper supplies the interpretation needed to put the contract in its proper light.

NAEC believes that the heart of the Dixon-Yates-AEC contract is "simply whether an American company, competent and able to do the job, should have the opportunity to help supply the electric power needed for atomic development."

The material was prepared to aid electric companies answer the many questions they are receiving concerning the AEC-Middle South-Southern contract. The paper carries quotations from a number of prominent men on the contract.

Atomic Energy . . . Consolidated Edison Co of New York now has available for its customers a brief, well-illustrated booklet on atomic energy. A sort of primer on the relative position of nuclear energy compared with other energy sources, the booklet touches on the prospect of producing electricity from atomic fuels.

The Con Edison booklet states, "The steam engine succeeded in competition with animal power because it could do a better job at a lower cost. It seems sure atomic fuels will succeed in competition with other fuels for the same reason."

St. Lawrence Power . . . One of the slickest of the recent pamphlets relating to industry matters comes from the New York State Power Authority which is publicizing its first big generation project. In a 14-page, 4-color, heavily illustrated booklet, the Authority tells the story of the St. Lawrence project in a manner designed to interest investment firms. The authority has a big job ahead in selling bonds to finance the construction.

Less Eager for Color TV

Some 60.8% of the television viewers questioned in the Los Angeles area said they are less eager to have a color TV set now than they were last year. The survey made by "Tele-Cenus" magazine further showed that if the price were the same 59.4% of the TV owners would prefer to watch first quality movies at home on TV and only 16.9% would prefer to go to the theater. The remaining 23.7% didn't care for either.

Better Copy Contest Deadline Set by PUAA

February 1 is the deadline for submitting entries in the 32nd annual Better Copy Contest sponsored by the Public Utilities Advertising Association. Only exception is that entries in the annual report classification will be accepted until April 1.

Twenty-three classifications are to be represented in the contest this year and a total of 183 awards will be made. Winners are to be announced at the Association's national convention in Chicago May 12 and 13.

A special classification has been included in this year's contest for the best "single Newspaper Advertisement on Light's Diamond Jubilee."

Rules books, containing complete instructions for entering the contest, are available from Ernest R. Laws, Contest Chairman, Philadelphia Electric Co, Philadelphia, Pa.

Scanning the Ads

Florida Power & Light Co—Series of institutional ads salutes industries and institution for their part in making and keeping America strong. One on the press is headed, "Freedom's first line of defense . . . our free press!" Illustration shows reporter at work.

Kansas Gas & Electric Co—"Relaxing as a lullaby" is the way an ad describes the wonders of electric bed covers. Illustration is drawing of a bear sleeping snugly under an electric blanket.

Public Service Electric & Gas of N. J.—"I'm bored with figures," moans a hippopotamus in a Public Service ad pushing its "Charmed Circle" area development program. Point is that while the hippo may not care about figures, the business executive does.

West Penn Electric System—Ad appearing in national magazines tells industry that West Penn Electric "can shop for you in a supermarket of plants and sites" in the service area of its operating companies.

READERS FORUM

Quick-Recovery Heater Needs Control

To the Editor:

Your editorial in the July 12 issue entitled, "Give the Customer What He Wants," conveys the idea that the domestic electric water heater load is not increasing as fast as it should because of the employment of antiquated methods by the power companies for serving this load. Perhaps this is true.

You apparently believe that it is necessary to put more power into the heater so that its recovery rate may become more nearly comparable to that of the gas heaters. I am inclined to agree with you on this point, but probably it would be necessary to employ the principle of heating a small amount of water quickly rather than heating a large amount of water slowly. This might necessitate the utilization of a high-wattage heating element located at the top of the tank. If this is done, the customer's needs might be well served, but to avoid undue power company costs, I believe some system of control is necessary. At least one system of control is now available which can meet both the requirements of the customer and the power company.

J. K. Ostrander
Consulting Electrical Engineer
United Engineers & Constructors Inc.
1401 Arch Street
Philadelphia 5, Pa.

• For a previous letter on this subject by Mr Ostrander see page 206 of the Nov. 15 issue.

A Third Comment on Nomenclature

To the Editor:

Individualism among engineers is important for the development of engineering, but it has no place in designating the same thing by different names. When this happens, confusion results; and people spend time looking for differences that could well be spent on more productive work.

A 277/480Y-v, 4-wire system should be the same and should be designated the same regardless of whether power or light is the major use on that particular system. Regardless of the amount of power load on any one of these systems, the lighting load will remain substantial.

In the years before 1949 the Edison Electric Institute and the National Electrical Manufacturers Association worked together and produced the Preferred Voltage Ratings for A-C Systems and Equipment. In May, 1949, they published the excellent results of their work in EEI Publication R-6 and NEMA Publication 117. Their tabulation in every case for the designation of a 4-wire system voltage listed the line-to-neutral voltage first and the line-to-line voltage second thus: 120/208Y, 2400/4160Y, 7200/12470Y.

It would appear to be desirable to continue this convention with new 4-wire systems. So let us standardize on the voltage designation for a 4-wire system by listing the line-to-neutral voltage first, followed by a slant line, followed by the line-to-line voltage.

In the order to avoid any confusion on this point it should be pointed out that the voltage designations 208Y/120, 4160Y/2400, 12470Y/7200, etc, have been adopted in the transformer standards to indicate transformers with windings designed for the Y connection with the lower voltage available from line-to-neutral. This designation is used to differentiate these transformers from those that have windings which may be connected for either delta or Y operation. They are useful designations for transformer standards but were never intended to supersede the nominal system voltage designations given in the EEI-NEMA Preferred Voltage Report.

Of equal importance in this connection is the work that industry committees are doing on the voltage level designation, that is, 277/480Y, 265/460Y, etc. One of the objectives of the EEI-NEMA Committee in preparing the report on preferred voltage ratings was to "establish uniform nomenclature in the field of voltages and reduce the number of nominal system voltages." This is an important objective, and we believe that it would be highly undesirable to have another nominal system voltage in this voltage class. The same utilization equipment would be used on a 480-v delta system. It seems that the voltage limits should be the same on the two systems and that the 480-v designation should be retained for both. Other designations such as 265/460Y do not follow the pattern of any of the nominal systems voltages recommended by the EEI-NEMA report and would introduce a new nominal voltage only slightly different from the present 480-v value.

E. Rothfus
J. A. Elzi

Commonwealth Associates, Inc
252 W. Cortland St
Jackson, Mich.

• For two other letters on this same subject, see p 130 of the Dec. 27, 1954 issue.

A Scot Suggests a Slogan

To the Editor:

I am tempted to reply to M. B. McDonald regarding his thought provoking letter in your issue of Oct. 18. By all means let us plan future load additions to present wiring, but can we afford to over-estimate the sizes required?

I am reluctant to agree that extensions to domestic or even industrial wiring jobs can be foreseen completely. There are always unexpected and unwanted factors to be taken into account.

Let us therefore, try to combine the requirements of expansion and watchfulness in a phrase such as—"Prediction Controlled Wiring."

W. T. McNair
Technical Engineer

Craigpark Electric Cable Co. Ltd
Flemington Street
Springburn, Glasgow, N, Scotland

WASHINGTON COMMENT

Congress to Look at Revenue Bonds for TVA Financing

Renewed efforts to wean the Tennessee Valley Authority away from direct federal appropriations are apparent as the 84th Congress gets underway. Most-discussed alternative to present TVA financing is the revenue bond by which the agency would raise its funds from private sources.

The idea is not new, but for the first time there are signs of serious interest on both sides of the political fence. Furthermore, there are at least two studies now underway aimed at determining the most appropriate way for TVA to secure its funds.

Most important of these is the Hoover Commission's task force study. Even though initiated by a Republican Congress, the Hoover Commission study is sure to command the respect and attention of Democratic leaders in the present Congress. The report will carry weight whether it recommends continuation of direct appropriations, a bond issue plan, or some other kind of program for TVA financing.

Presidential Study . . . Another study is being made by TVA General Manager Aubrey J. Wagner, reportedly at the personal direction of President Eisenhower. Wagner's boss, TVA Chairman Herbert D. Vogel, is already convinced that a revenue bond approach is the most practical way to finance TVA construction.

Some in favor of the bond approach argue that TVA must be "freed" from the annual football game involved in getting funds from Congress. They feel that review of the President's budget requests is conducted in a political atmosphere which emphasizes things other than the economic, financial, and social needs of a single region. These bond advocates argue that their plan would make available sufficient capital to enable TVA to meet the power requirements of its service area. However, it is generally understood that Congress will continue to have a measure of control over TVA activities.

One group of those opposed to a bond plan note that Section 10 of the Act was specifically amended to permit TVA to become the sole supplier of electric power from its customers. This, they argue, places a utility responsibility on the federal government to meet the power requirements of TVA customers. Another anti-bond group see the bond plan as a device for cutting TVA loose from all Congressional control and enabling it to obtain all of the low-cost money it needs for power expansion. Unless Congress keeps a checkrein on this power monster, they argue, the agency would be allowed to expand interminably after the federal government has already given it a billion dollar start on its competitors.

Of course there are wide differences of opinion among those who support the revenue bond idea. Some want the plan instituted for the purpose of freeing TVA from Congressional control. Others want the agency taken out of the federal budget and made to compete on the open market for its cash in the hope that TVA will at least pay some interest on its capital investment. Rep Charles R. Jonas, North Carolina Republican and a member of the House Committee overseeing TVA funds, believes the agency should compete for its funds in this way.

Selling Conditions . . . The crux of the bond issue question is the conditions under which the securities would be sold. There are those who oppose any bond plan featuring federal backing. Yet it is difficult to understand how the government's investment is to be protected without some control. And with control comes government responsibility.

Here are some of the questions being posed in connection with the TVA revenue bond discussions:

- Will TVA's obligations to the federal government be subordinated to the payment of bond interest? Or to put it another way, who would have first call on the power revenues of a bond-financed TVA?
- Will the government back TVA bond issues?
- How much money would be raised through bonds?
- What would be the allowable rate of interest?
- Would bond returns be tax-exempt?
- Would the bonds be issued on the public market, or would the Federal Reserve Board, for instance, take a hand in distributing them?

Any one of these questions could spark a debate in the Senate that might run for days. But if the majority of the lawmakers are sincerely seeking an alternative to the direct appropriations for TVA, a revenue bond plan is a possible answer.

TECHNICAL NOTES

Slow start of a turbine can conceivably do more damage to the machine than a quick start because the long roll accentuates the temperature differentials.

Heavy water achieves neutron moderation better than any known usable material and can be used in either the heterogeneous or homogenous type of reactor.

Improper application of materials in equipment grounding systems in connection with industrial power distribution circuits is not only wasteful but creates a false sense of security.

Performance of a high-voltage voltage divider is ascertainable from radio frequency measurements if suitable precautions are taken in the layout of the measuring circuit.

A mat of foam rubber makes a good spot on which to lay delicate instrument parts in the laboratory instrument repair shop.

Preheating of generator fields is recommended as regular operating practices for 3,600-rpm units 100,000 kw and up and for 1,800-rpm units 125,000 kw and up.

Central Maine Power Co Receives $1.1 Million a Year Rate Increase

Acting on a decision of the Maine Supreme Judicial Court that required a proper finding of a fair value rate base, the Maine Public Utilities Commission granted Central Maine Power Co an increase of $1.1 million a year. William F. Wyman is president of Central Maine Power.

The history of this rate increase goes back to Dec. 29, 1952 when the company filed with the PUC for a rate increase of $3,284,389, or 13.74%. On Nov. 6, 1953 the commission granted one rate increase of $750,000 and followed shortly thereafter with another rate increase of $670,000, the purpose of which was to ". . . cover federal income taxes at the rate of 52% until such time as the then federal income tax rates might be reduced."

Company Objects

The company took exception to both these increases and took the PUC to court on the grounds that among other things the commission failed to make a proper finding of fair value of the company's property. The order went on to say "The court on Oct. 21, 1954 rendered its decision specifically sustaining six of the 19 exceptions and remanded the case to the commission for a decree upon the existing record in accordance with its opinion. The following decree of this commission is drafted pursuant to that mandate."

In its original finding of fair value, the PUC added $4 million to the company's original cost rate of $128 million or an increase of 3%. It is significant that in a recent telephone case, the Maryland Court of Appeals sustained the Maryland commission in its findings of fair value which amounted to 2.66% over net original cost.

However, in this instance acting under the mandate of the Court, the PUC found fair value to be $141 million which is 9.1% over the new original cost rate base of $129,100,000.

In its new findings on the fair rate of return, the order significantly stated "In the original decree in this case the commission found that 'Considering all the evidence before us, including various bases of property value, we find that under these present circumstances a rate of return of 5.9% is just and reasonable on a rate base of $132 million.' There was considerable evidence introduced on the subject of the rate of return by two expert witnesses. We are convinced that a fair and reasonable rate of return will vary depending upon the corresponding weight given to original and current costs in the rate base."

The order continued "Considering all the evidence before us, including various bases of property value and evidence as to return requirements in the record, we find that under the conditions included in this evidence a rate of return of 5.8% is just and reasonable on a rate base of $141 million. This will result in a return to the company of $8.2 million.

"Revised rates are, therefore, necessary to provide additional gross revenues of $1.1 million above rates now in effect by the earlier decrees. This amount is designed to include the above increased return, adjustment in allowance for pension and depreciation expenses, with allowances for federal income taxes."

Concurring Opinion

In a concurring opinion, Commissioner Edgar F. Corliss said that he was unable to follow the majority's reasoning in reducing the fair return from 5.9% to 5.8% merely because of an increase in the fair value component of the rate base. Corliss said

WILLIAM F. WYMAN

"Having found a fair rate of return on fair value in our original decree, it is my opinion that we cannot now consistently find a lower rate of return on the same record from which we made our original determination. Conversely, if the court had ordered a lower fair value rate base, I believe we would not be justified in increasing the rate of return. I recognize that this particular question is debatable but feel compelled to express my opinion."

Courts Disagree

Corliss, after noting that there was no unanimity among courts and commissions as to the amount which is to be attributed to fair value pointed out that the Maryland Court of Appeals recently sustained that state's commission when it found a fair value rate base to be 2.66% over and above the net original cost rate (not including working capital) in the case of Chesapeake & Potomac Telephone Co.

Corliss concluded "It is my judgment in the case under consideration that a fair value rate base arrived at after taking into consideration all statutory requirements should more properly be in a range between $138 million and $139 million than the $141 million arrived at by the ma-

jority. Although a fair value rate base is not susceptible to mathematical formulae the base which I have suggested does result in an increase of between 6% and 7% over an original cost less depreciation base. Any small difference between my result and that of the majority in the dollars required, after applying the respective rates of return, becomes insignificant."

FINANCIAL BRIEFS

A suit seeking recovery of a total of $642,429.88 plus interest from Dec. 3, 1947, representing federal taxes allegedly assessed and collected illegally by the U. S. Bureau of Internal Revenue, has been filed on behalf of the North American Light & Power Co in the U. S. District Court in Wilmington, Del.

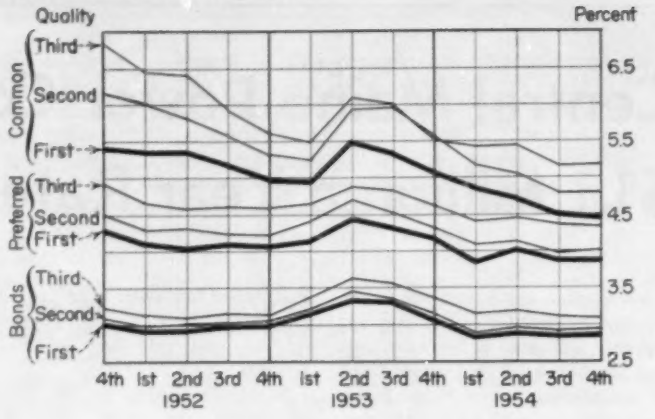
Pennsylvania Power & Light Co has asked Federal Power Commission and the Pennsylvania Public Utilities Commission approval to merge Pennsylvania Water & Power Co into it. Stockholders of both companies have already approved the merger.

Quebec Hydro-Electric Commission is planning to sell $50 million in securities in the New York market . . . **Florida Power Corp** and its subsidiary Georgia Power & Light Co are expected to spend $110 million for expansion through 1958.

In reply to a question on the rate of return, Jerome K. Kuykendall, chairman, Federal Power Commission, speaking before the New York Society of Security Analysts said that, while the "cost of money" could not be ignored, it should not govern the rate of return. It is an important factor, but not the only one and not the controlling one, he pointed out.

California Electric Power Co has received California Public Utilities Commission approval to increase rates by $1,207,000 a year . . . Federal Power Commission has approved **Bonneville Power Administration's** rate schedules based on $17.50 per kilowatt year through Dec. 20, 1956 and permitting readjustments in December and/or each December through 1958 to cover higher generation costs.

Today's Utility Yields (%)



	BONDS			PREFERRED STOCKS			COMMON STOCKS		
QUALITY	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Dec. 30	2.89	2.92	3.10	3.93	4.04	4.37	4.34	4.75	5.16
Dec. 23	2.89	2.92	3.11	3.90	4.04	4.38	4.36	4.70	5.20

Data: Reis & Chandler, Inc.

Utility Earnings

	PERIOD MONTHS ENDED		NET INCOME 1954	NET INCOME 1953	EARNINGS PER COMMON SHARE 1954	EARNINGS PER COMMON SHARE 1953
Consumer Power	12	Nov.	$26,458,808	$24,295,424	$3.09(a)	$3.08(a)
Iowa Southern Utilities	12	Nov.	1,174,905	1,342,803	1.41(b)	1.64(b)
Kansas City Power & Light	12	Nov.	7,115,410	6,588,415	2.34(c)	2.45(c)
Middle South Utilities consolidated	12	Nov.	16,240,449	14,723,497	2.16(f)	2.07(f)
Portland General Electric	12	Nov.	4,276,284	3,791,261	1.43	1.26
Southern Co, consolidated	12	Nov.	23,438,842	22,319,309	1.29	1.22
Southern Indiana Gas & Electric	12	Nov.	2,429,019	2,142,879	2.21(g)	2.17(g)
Virginia Electric & Power	12	Nov.	16,397,578	12,745,723	2.35(h)	1.93(h)
West Penn. Electric, consolidated	12	Nov.	15,676,429	14,436,550	3.71	3.41

Notes—(a) Based on 7,473,798 shares in 1954 and 6,794,362 shares in 1953; (b) Based on 745,131 shares in 1954 and 731,105 shares in 1953; (c) Based on 2,450,000 shares in 1954 and 2,224,540 shares in 1953; (f) Based on 7,600,000 shares in 1954 and 7,125,000 shares in 1953; (g) Based on 913,333 shares in 1954 and 799,167 shares in 1953; and (h) Based on 6,002,181 shares in 1954 and 5,441,034 shares in 1953.

Utility Financing

COMPANY AND DESCRIPTION	AMOUNT OF OFFERING (000)	OFFERING PRICE	YIELD TO PUBLIC
SCHEDULE FOR JANUARY			
BONDS AND DEBENTURES			BID DATE
Duke Power—1st mtg due 1975	$40,000	.....	Jan. 10
Commonwealth Edison—conv. debs due 2004	50,000	.....	Jan. 11
New England Power—1st mtg due 1985	25,000	.....	Jan. 18
Consumers Power—1st mtg due 1990	30,000	.....	Jan. 25
Los Angeles, Calif., Department of Water & Power electric plant revenues	18,000	.....	Jan. 26
PREFERRED STOCK			
Public Service Electric & Gas 250,000 sh $100 par cum	$25,000	.....	Jan. 11
Duquesne Light—160,000 sh $50 par	8,000	.....	Jan. 20
COMMON STOCK			
Duke Power—218,737 sh (to be offered commonholders on 1-for-20 basis, record Jan. 12 to expire Jan. 28, no underwriting)	$8,749	$40.00	5.00%
Duquesne Light—450,000 sh	.....	.....	Jan. 17

STATISTICS

A Preview of EW's 51st Statistical Issue*

Production . . . 472 billion kwhr, up 7% over 1953.

Capacity . . . year end capacity rose to 102 million kw as a result of 12 million kw of new additions during the year.

Sales . . . totalled 410 billion kwhr, an increase of 25 billion kwhr (7%) over 1953. Sales to industrial customers totalled 198 billion kwhr, a 4% increase over 1953. Residential sales were 108 billion kwhr, up 11%.

Customers . . . by the end of the year 51 million were being served. Electricity is now serving 98% of the occupied homes.

Residential Use . . . Consumption in the average home increased by 194 kwhr with total use amounting to 2,540 kwhr during the year. Use of electricity by domestic consumers now accounts for 26% of all sales. Average cost to the residential consumer was 2.69 cents per kwhr, a 2% reduction.

Revenues . . . the industry's gross revenues amounted to $7.3 billion, up 7% over 1953.

* January 24, 1955

Power Statistics . . .

		Latest Month	Preceding Month	Year Ago	Annual Change %
Capacity	Oct.	100.01	99.16	88.62	12.9
Peak—Class I Systems, million kw	Oct.	79.9	79.4	74.0	8.0
Estimated Dec. '54 Peak	Sept.	87.8	88.0	91.2	− 3.7
Production—billion kwhr	Sept.	39.55	41.17	37.03	6.8
hydro		7.80	8.34	7.59	2.8
fuel		31.74	32.82	29.44	7.8
Sales—billion kwhr	Oct.	33.75	34.05	32.21	4.8
residential		9.70	9.76	8.70	11.5
commercial		6.40	6.69	5.62	13.9
industrial		15.24	15.00	15.56	− 2.1
other		2.41	2.60	2.33	3.4
Fuel Consumption	Sept.				
coal—million tons		9.73	9.83	9.67	0.6
oil—million barrels		4.90	4.85	6.16	−20.5
gas—billion cu ft		118.62	130.49	105.14	12.8
Net Income Class A & B Co's—$ million	Sept.	92.41	89.43	80.66	14.6
Residential Customers—millions		42.95	42.84	41.79	2.8
revenue per kwhr	12 mos.	2.70¢	2.70¢	2.75¢	− 1.8
avg kwhr per customer	ended	2,512	2,496	2,317	8.4
avg annual bill	Oct.	$67.82	$67.39	$63.72	6.4

Business Statistics . . .

Indexes: 1947-49 = 100					
FRB Industrial Production	Nov.	130	130	130	.....
ENR Construction Cost	Dec.	134.9	134.8	128.2	5.2
BLS Cost-of-living	Nov.	114.6	114.5	115.0	− 0.3
NEMA Sales	Oct.				
insulation materials		117	123	154	−24.0
electric appliances		102	115	91	12.1
household refrigerators		51	73	46	10.9
Wholesale prices	Nov.				
motors and generators		121.8	121.8	124.3	− 2.0
transformers and regulators		128.1	128.1	128.1	.....
switchgear and fuses		135.2	135.1	135.00	0.1
GNP—annual rate—$ billion	3rd qtr	355.5	356.0	367.2	− 3.2

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One of a series of advertisements prepared by THE ASSOCIATED BUSINESS PUBLICATIONS

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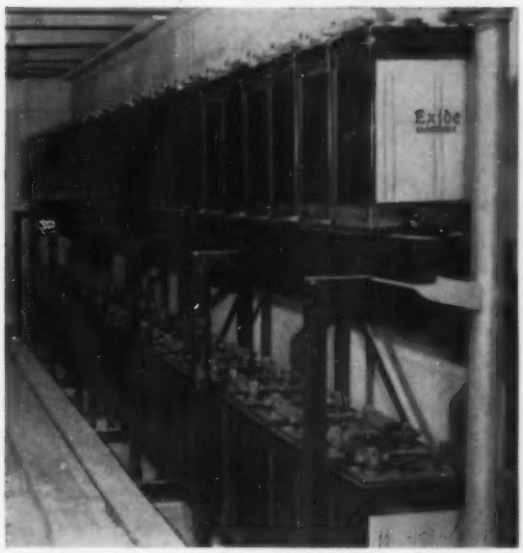
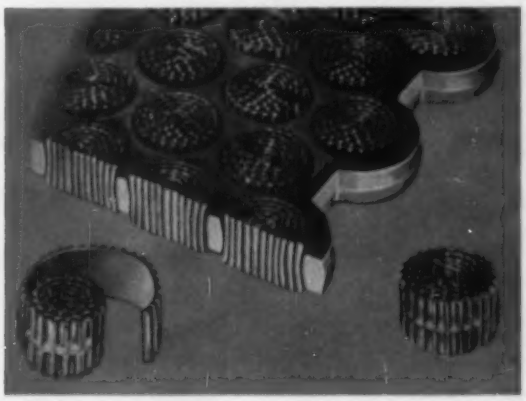
. . . with dependable Exide-Manchex batteries!

THE ATOMIC ENERGY COMMISSION'S Paducah Area Project demands a tremendous supply of power, about half of which is furnished by the Joppa, Ill., Steam Electric Station of Electric Energy, Inc. Dependability of all equipment is the prime requisite. It is significant that the four boiler and turbine units at this vital station, generating 650,000 kw, rely on Exide-Manchex batteries for *positive operation* of switchgear at ample voltage. Instant power for all other control circuits and for emergency lighting is assured. In addition, lower costs for operation, maintenance and depreciation make Exide-Manchex *your best battery buy* for all control and substation services!



HERE ARE HALF of the two 120 cell FME-15 Exide-Manchex batteries installed at the Joppa Station. Assure dependable power, easy maintenance (water is needed only about twice a year) by buying Exide-Manchex batteries. For full details, call your Exide sales engineer—write for form 5001 (Engineering and Maintenance Manual).



THE POSITIVE PLATES are the heart of any battery. Only Exide-Manchex have the famous manchester positive plates with buttons of active material. These buttons, inserted in a strong alloy grid, assure you of *high capacity* in a compact space, with an unusually long battery service life.

Your best battery buy
. . . for all control and substation services

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Exide INDUSTRIAL DIVISION, The Electric Storage Battery Company, Philadelphia 2, Pa.

Curvacore DESIGN EXTENDED TO 500 kva

NOW a complete line of smaller, lighter, single-phase distribution transformers

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As much as 20% savings in weight have been effected by the application of *Curvacore* design to the larger sizes. Handling is easier, installation takes less time. More capacity can be installed on a pole.

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